

Figure 1

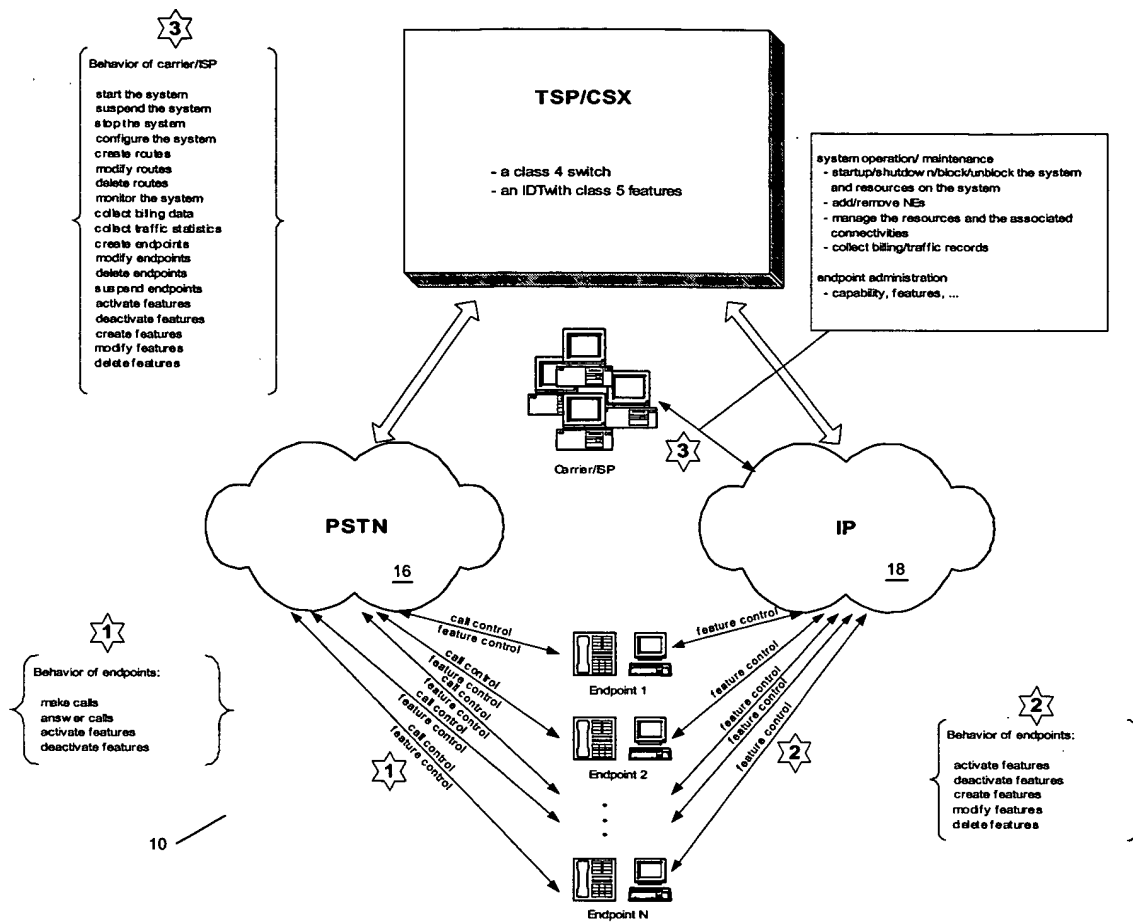


Figure 2

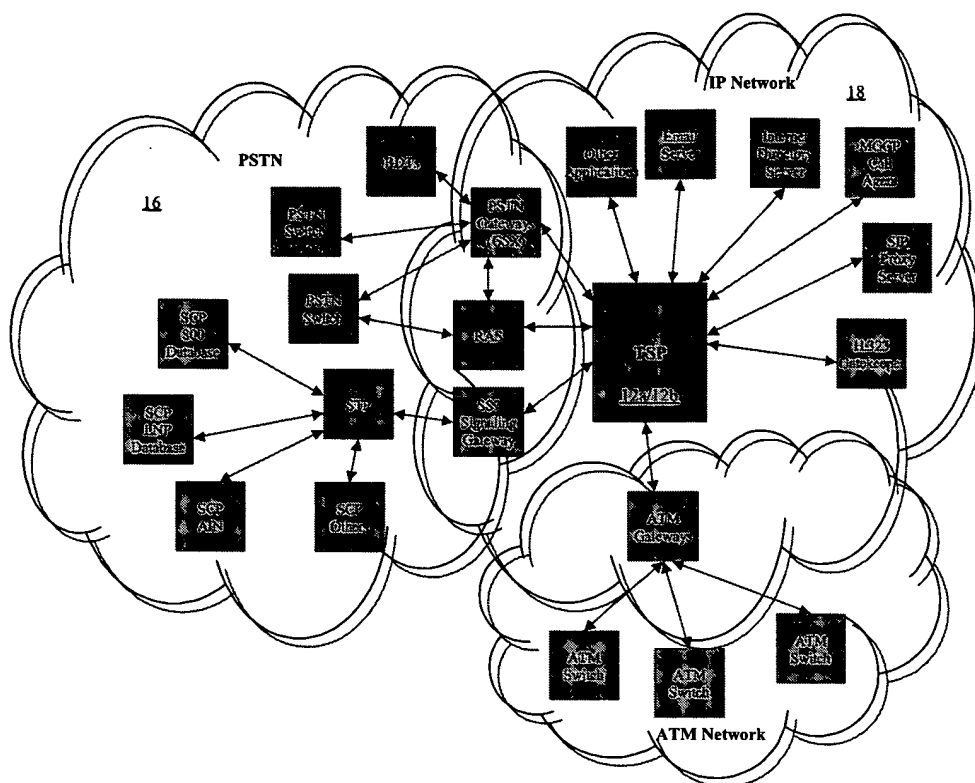


Figure 3

1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055 2056 2057 2058 2059 2060 2061 2062 2063 2064 2065 2066 2067 2068 2069 2070 2071 2072 2073 2074 2075 2076 2077 2078 2079 2080 2081 2082 2083 2084 2085 2086 2087 2088 2089 2090 2091 2092 2093 2094 2095 2096 2097 2098 2099 2100 2101 2102 2103 2104 2105 2106 2107 2108 2109 2110 2111 2112 2113 2114 2115 2116 2117 2118 2119 2120 2121 2122 2123 2124 2125 2126 2127 2128 2129 2130 2131 2132 2133 2134 2135 2136 2137 2138 2139 2140 2141 2142 2143 2144 2145 2146 2147 2148 2149 2150 2151 2152 2153 2154 2155 2156 2157 2158 2159 2160 2161 2162 2163 2164 2165 2166 2167 2168 2169 2170 2171 2172 2173 2174 2175 2176 2177 2178 2179 2180 2181 2182 2183 2184 2185 2186 2187 2188 2189 2190 2191 2192 2193 2194 2195 2196 2197 2198 2199 2200 2201 2202 2203 2204 2205 2206 2207 2208 2209 2210 2211 2212 2213 2214 2215 2216 2217 2218 2219 2220 2221 2222 2223 2224 2225 2226 2227 2228 2229 2230 2231 2232 2233 2234 2235 2236 2237 2238 2239 2240 2241 2242 2243 2244 2245 2246 2247 2248 2249 2250 2251 2252 2253 2254 2255 2256 2257 2258 2259 2260 2261 2262 2263 2264 2265 2266 2267 2268 2269 2270 2271 2272 2273 2274 2275 2276 2277 2278 2279 2280 2281 2282 2283 2284 2285 2286 2287 2288 2289 2290 2291 2292 2293 2294 2295 2296 2297 2298 2299 2300 2301 2302 2303 2304 2305 2306 2307 2308 2309 2310 2311 2312 2313 2314 2315 2316 2317 2318 2319 2320 2321 2322 2323 2324 2325 2326 2327 2328 2329 2330 2331 2332 2333 2334 2335 2336 2337 2338 2339 2340 2341 2342 2343 2344 2345 2346 2347 2348 2349 2350 2351 2352 2353 2354 2355 2356 2357 2358 2359 2360 2361 2362 2363 2364 2365 2366 2367 2368 2369 2370 2371 2372 2373 2374 2375 2376 2377 2378 2379 2380 2381 2382 2383 2384 2385 2386 2387 2388 2389 2390 2391 2392 2393 2394 2395 2396 2397 2398 2399 2400 2401 2402 2403 2404 2405 2406 2407 2408 2409 2410 2411 2412 2413 2414 2415 2416 2417 2418 2419 2420 2421 2422 2423 2424 2425 2426 2427 2428 2429 2430 2431 2432 2433 2434 2435 2436 2437 2438 2439 2440 2441 2442 2443 2444 2445 2446 2447 2448 2449 2450 2451 2452 2453 2454 2455 2456 2457 2458 2459 2460 2461 2462 2463 2464 2465 2466 2467 2468 2469 2470 2471 2472 2473 2474 2475 2476 2477 2478 2479 2480 2481 2482 2483 2484 2485 2486 2487 2488 2489 2490 2491 2492 2493 2494 2495 2496 2497 2498 2499 2500 2501 2502 2503 2504 2505 2506 2507 2508 2509 2510 2511 2512 2513 2514 2515 2516 2517 2518 2519 2520 2521 2522 2523 2524 2525 2526 2527 2528 2529 2530 2531 2532 2533 2534 2535 2536 2537 2538 2539 2540 2541 2542 2543 2544 2545 2546 2547 2548 2549 2550 2551 2552 2553 2554 2555 2556 2557 2558 2559 2560 2561 2562 2563 2564 2565 2566 2567 2568 2569 2570 2571 2572 2573 2574 2575 2576 2577 2578 2579 2580 2581 2582 2583 2584 2585 2586 2587 2588 2589 2590 2591 2592 2593 2594 2595 2596 2597 2598 2599 2600 2601 2602 2603 2604 2605 2606 2607 2608 2609 2610 2611 2612 2613 2614 2615 2616 2617 2618 2619 2620 2621 2622 2623 2624 2625 2626 2627 2628 2629 2630 2631 2632 2633 2634 2635 2636 2637 2638 2639 2640 2641 2642 2643 2644 2645 2646 2647 2648 2649 2650 2651 2652 2653 2654 2655 2656 2657 2658 2659 2660 2661 2662 2663 2664 2665 2666 2667 2668 2669 2670 2671 2672 2673 2674 2675 2676 2677 2678 2679 2680 2681 2682 2683 2684 2685 2686 2687 2688 2689 2690 2691 2692 2693 2694 2695 2696 2697 2698 2699 2700 2701 2702 2703 2704 2705 2706 2707 2708 2709 2710 2711 2712 2713 2714 2715 2716 2717 2718 2719 2720 2721 2722 2723 2724 2725 2726 2727 2728 2729 2730 2731 2732 2733 2734 2735 2736 2737 2738 2739 2740 2741 2742 2743 2744 2745 2746 2747 2748 2749 2750 2751 2752 2753 2754 2755 2756 2757 2758 2759 2760 2761 2762 2763 2764 2765 2766 2767 2768 2769 2770 2771 2772 2773 2774 2775 2776 2777 2778 2779 2780 2781 2782 2783 2784 2785 2786 2787 2788 2789 2790 2791 2792 2793 2794 2795 2796 2797 2798 2799 2800 2801 2802 2803 2804 2805 2806 2807 2808 2809 2810 2

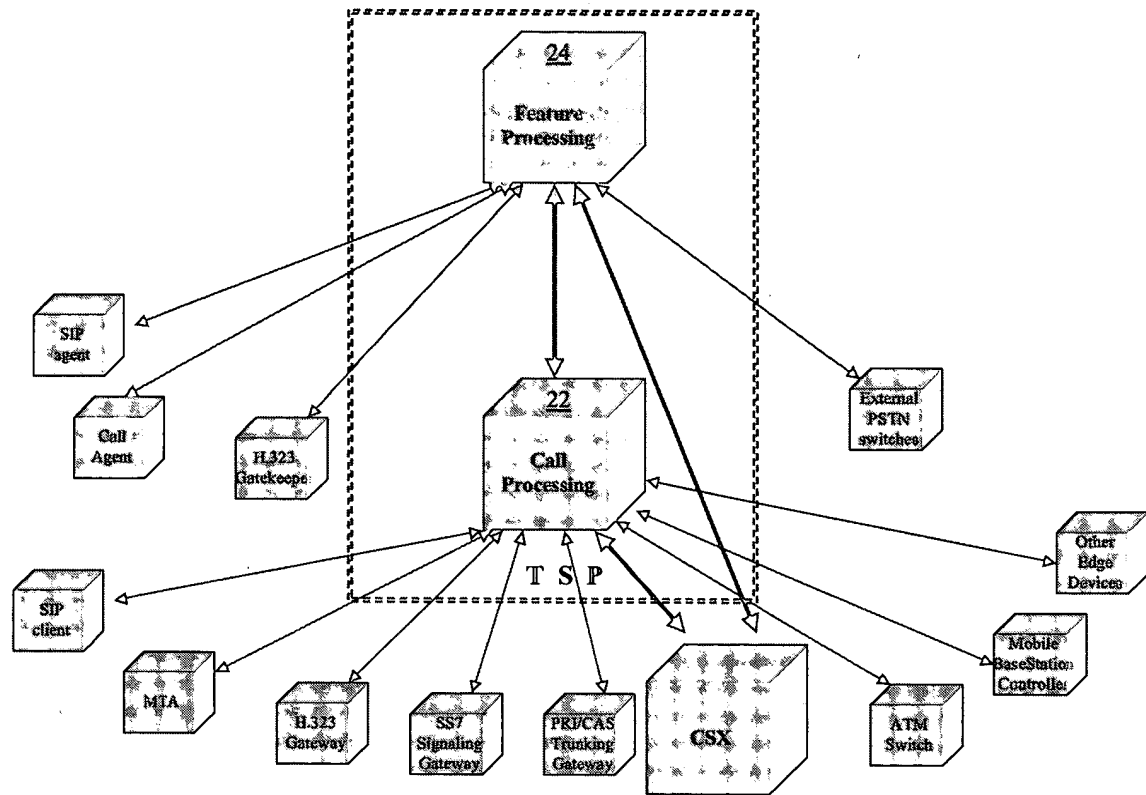


Figure 4



Figure 5

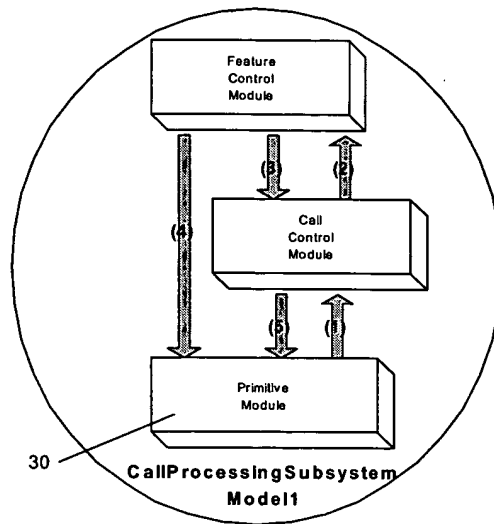


Figure 6A

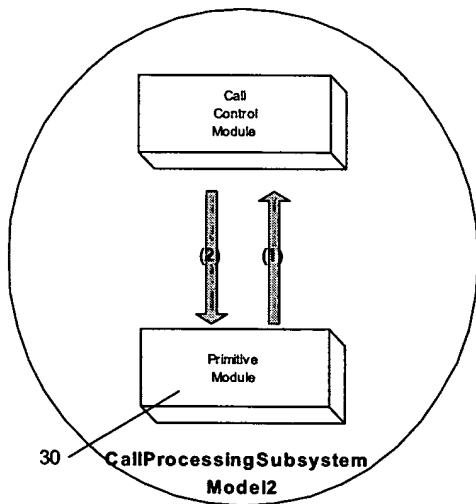


Figure 6B

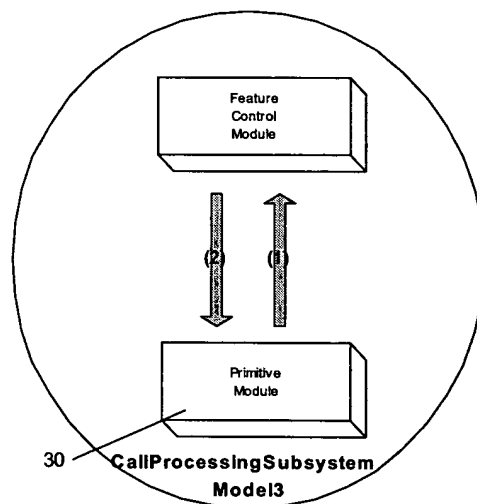


Figure 6C

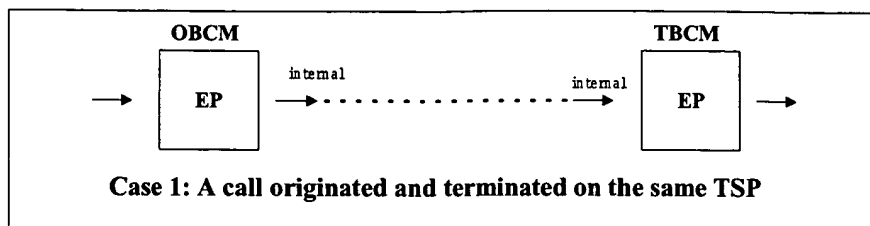


Figure 7A

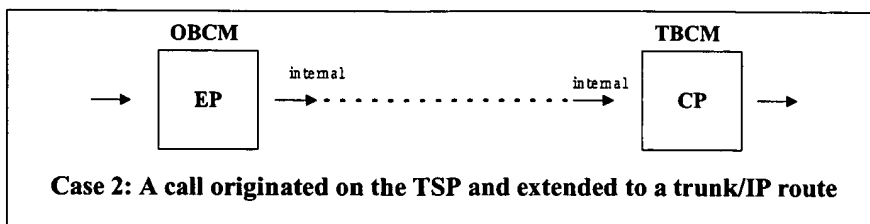


Figure 7B

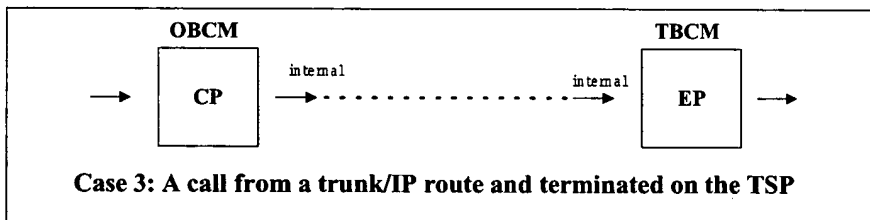


Figure 7C

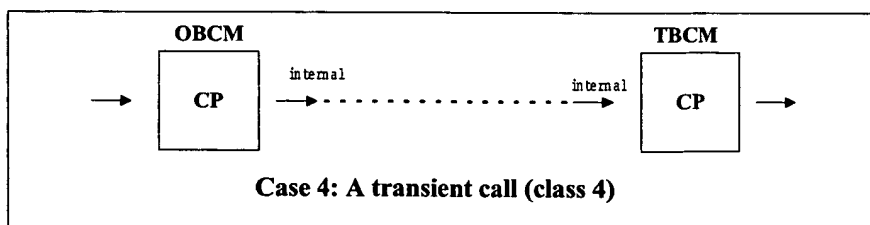


Figure 7D

30A

Feature Mask	Feature Logic Object
000	NULL
001	CND_FLO
010	CFBL_FLO
011	CFBL_FLO
100	CW_FLO
101	CW_CND_FLO
110	CW_CFBL_FLO
111	CW_CFBL_CND_FLO

feature mask = abc where

bit a – Call Waiting (CW)

bit b – Call Forwarding Busy Line (CFBL)

bit c – Calling Number Delivery (CND)

User defined features are not included in this table.

Figure 8

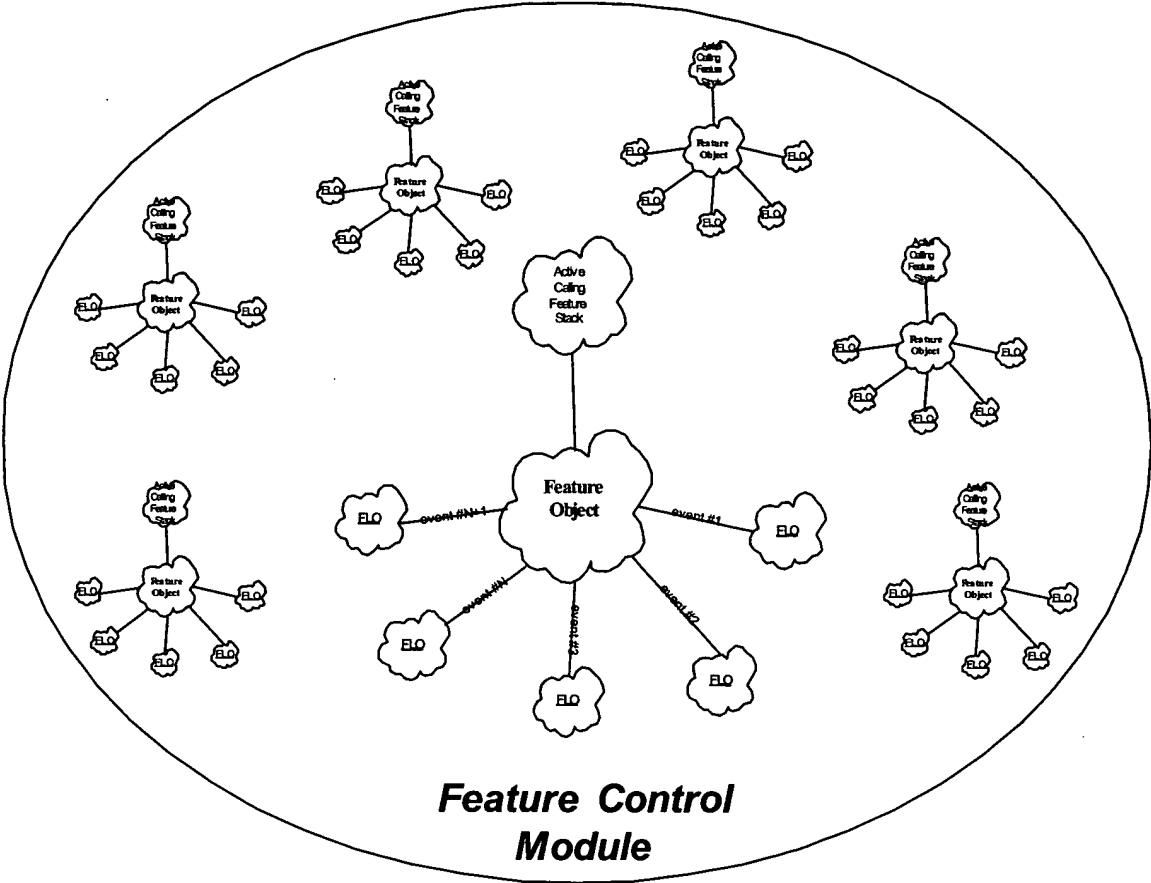


Figure 9

Approved for Release by NSA on 09-08-2013 pursuant to E.O. 13526

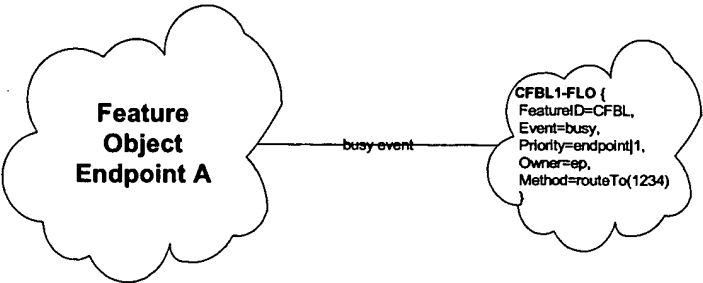


Figure 10A

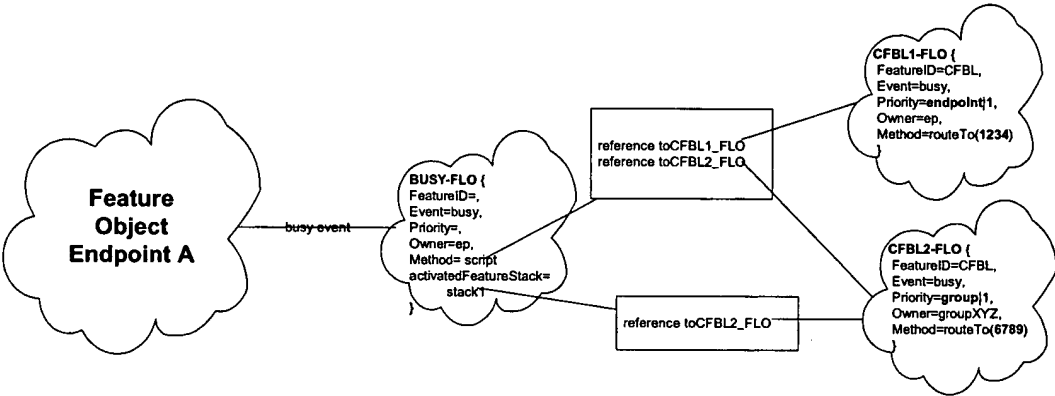


Figure 10B

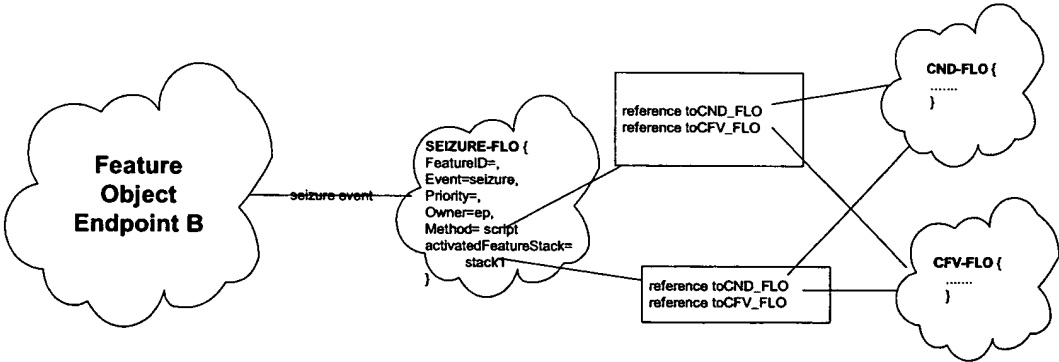


Figure 10C

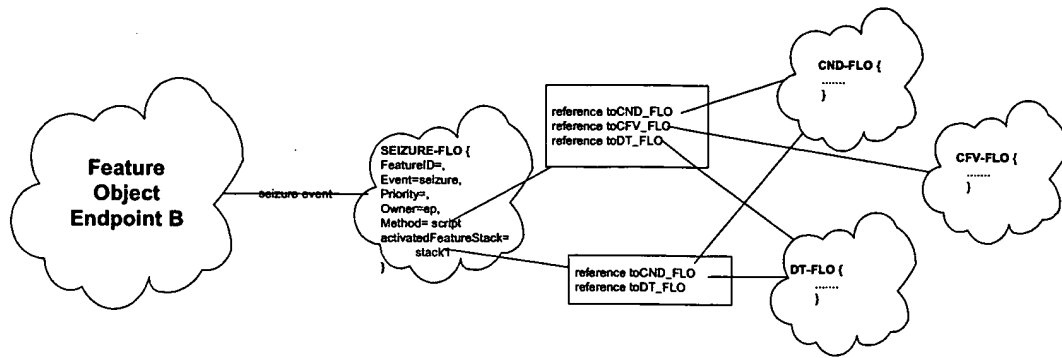


Figure 10D

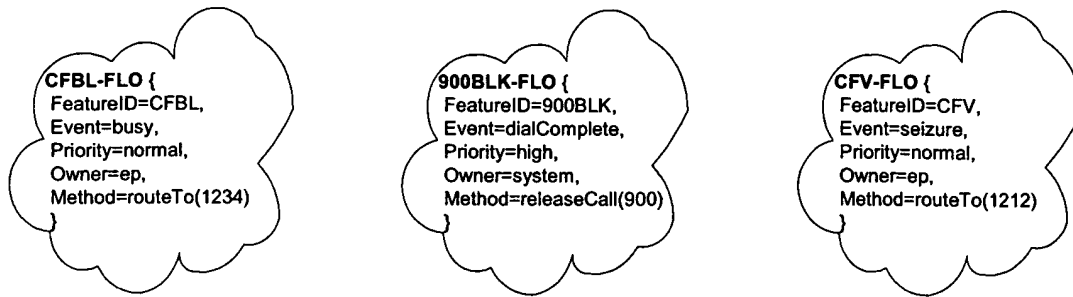


Figure 11A

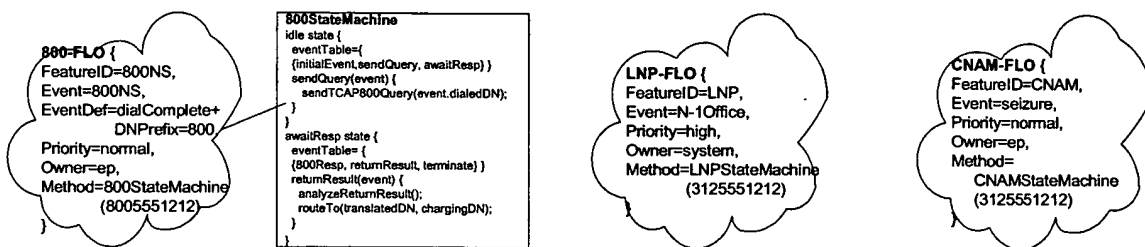


Figure 11B

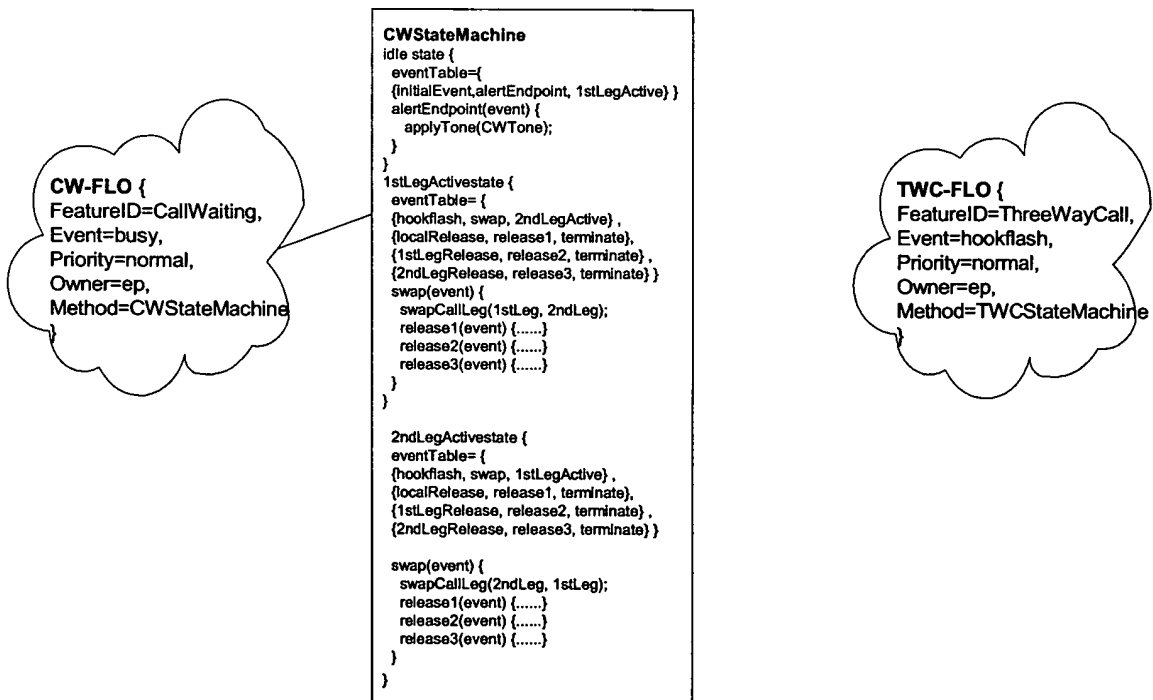


Figure 11C

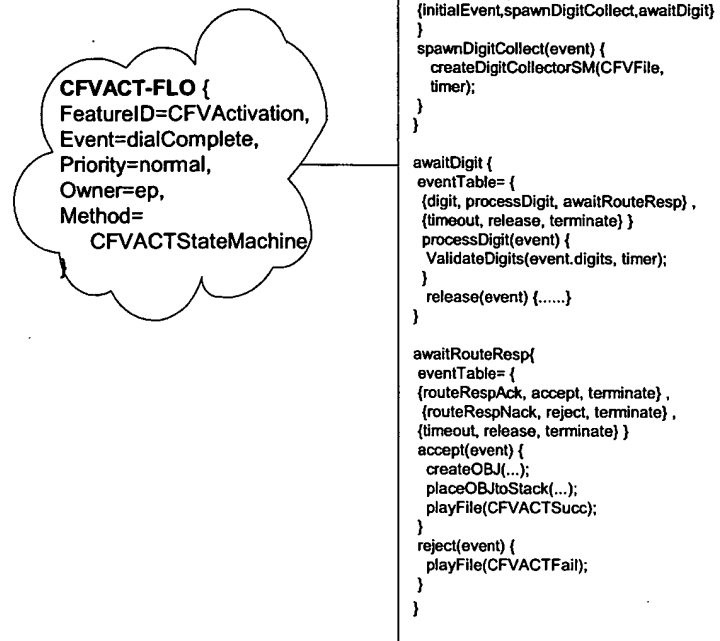


Figure 11D

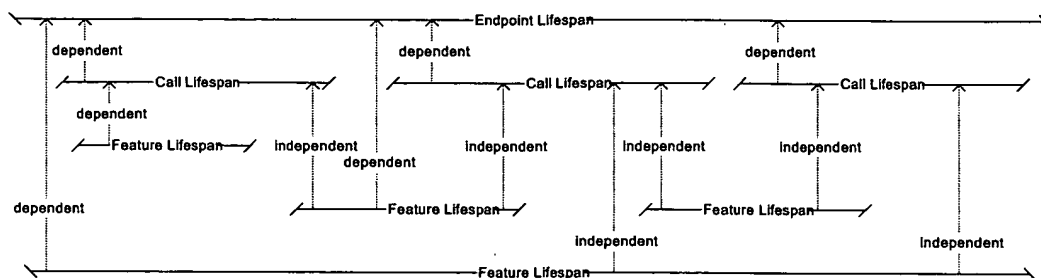


Figure 12

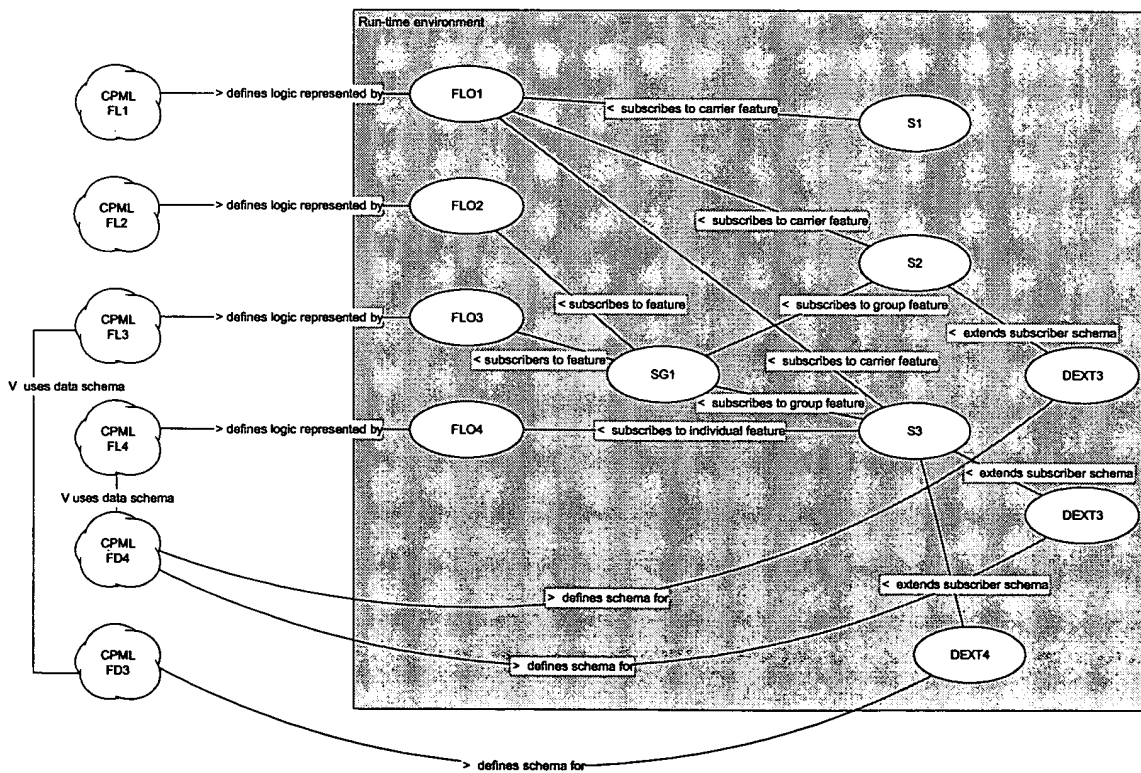


Figure 13

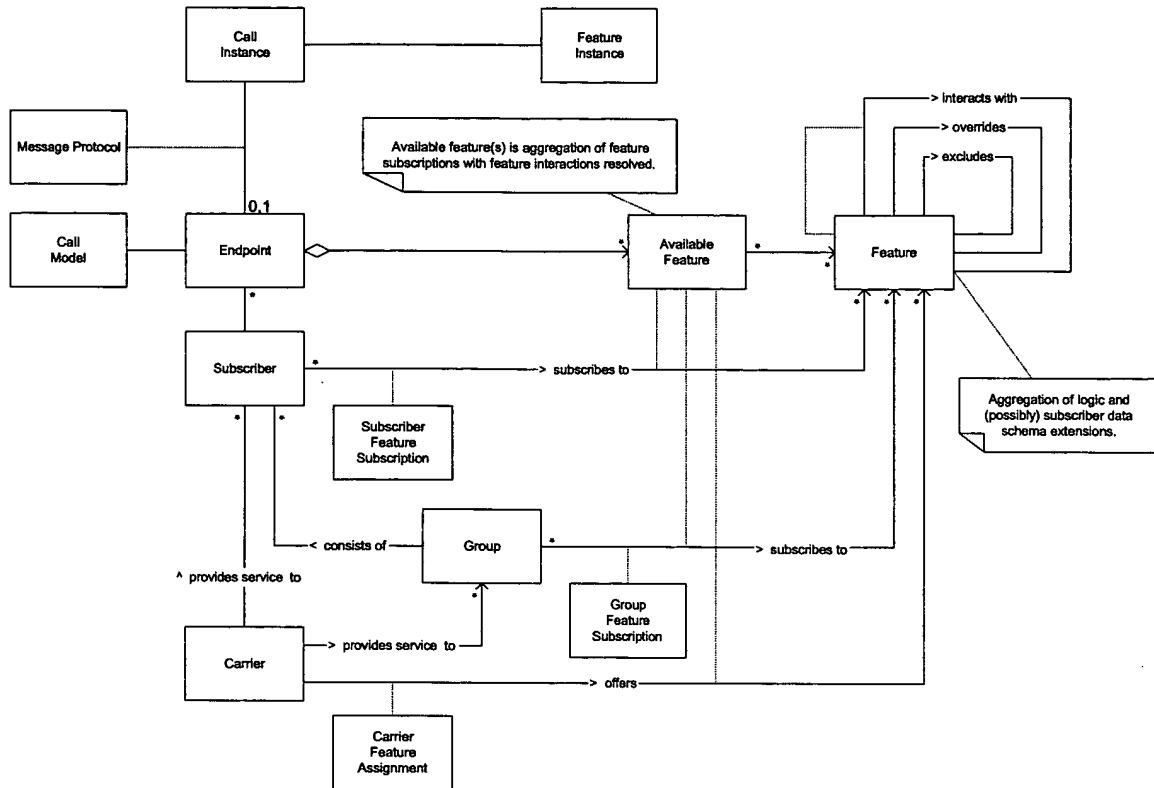


Figure 14



Figure 15

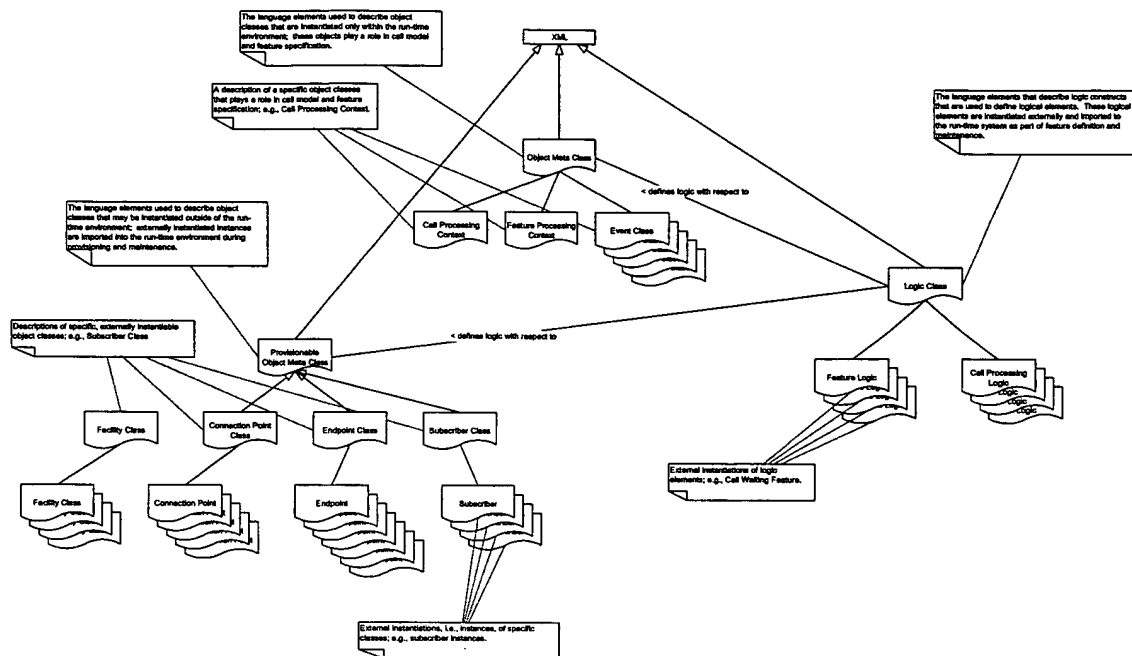


Figure 16

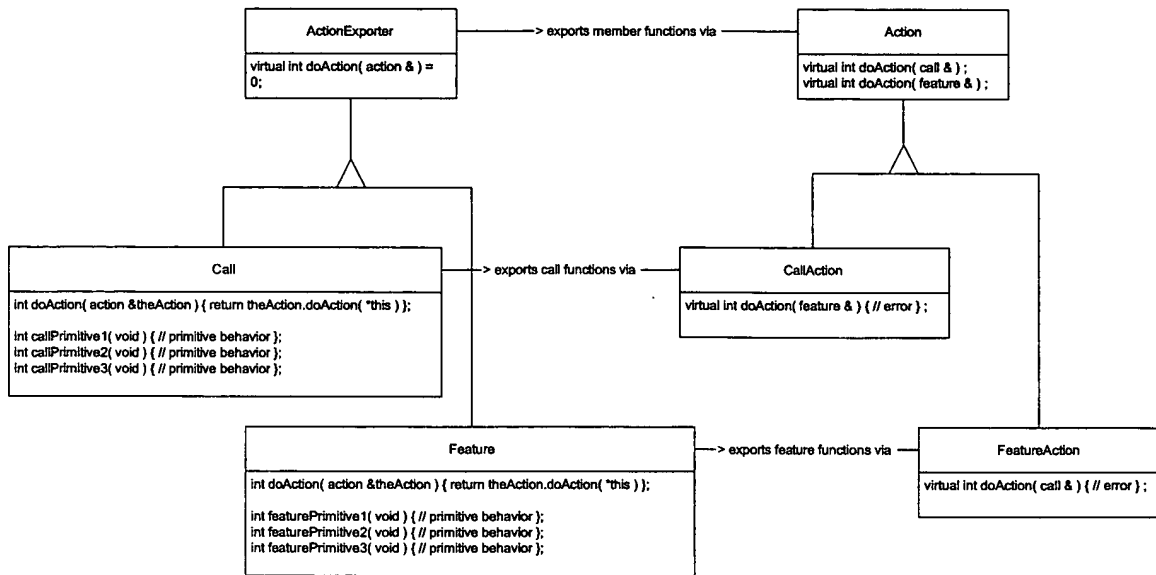


Figure 17

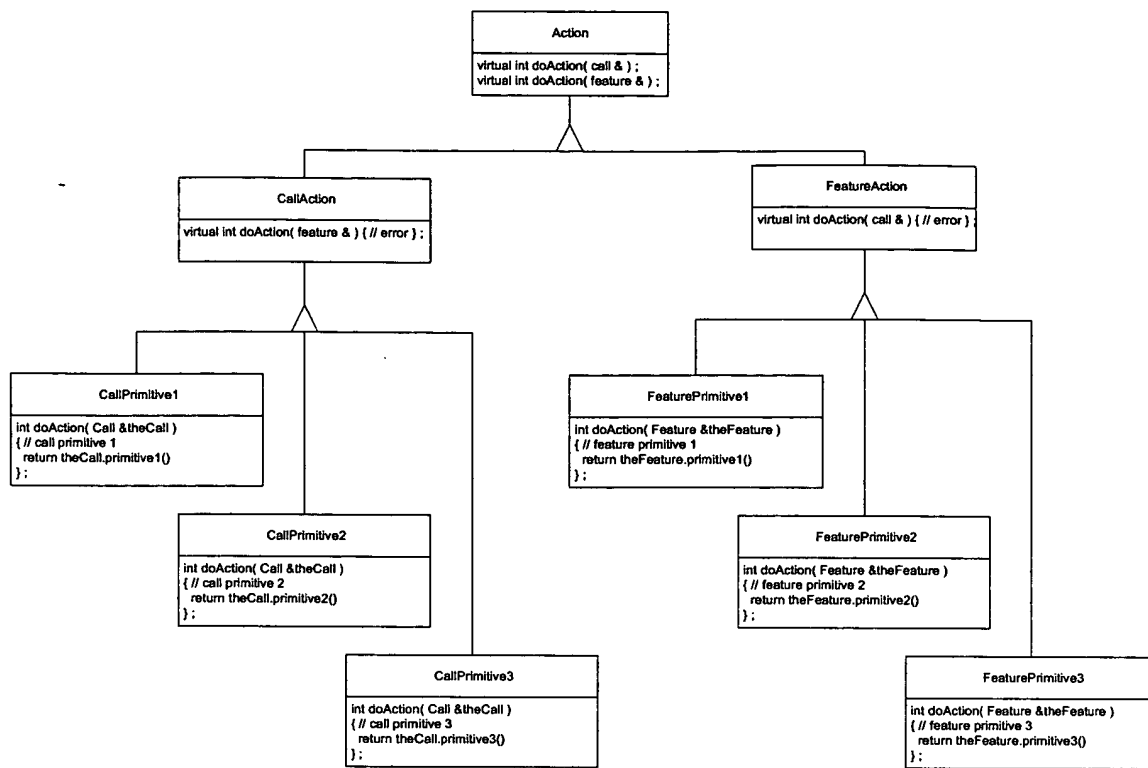
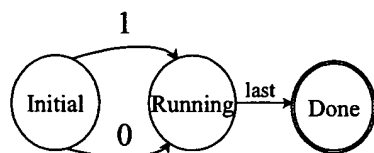


Figure 18



```

(EvenParityLogic
  (Initial (1Bit (()) (Set odd) (Running))
    (0Bit (()) (Set even) (Running))
    (Last (()) (Print "Error!") (Initial))
  )
  (Running (1Bit ((IsOdd?) (Set even) (Running))
    ((IsEven?) (Set odd) (Running))
  )
    (0Bit (()) (Running))
  )
  (Last ((IsOdd?) (Print "Bad!") (Done))
    ((IsEven?) (Print "Good!") (Done))
  )
)
(Done ()))
  
```

```

(OddParityLogic
  (Initial (1Bit (()) (Set odd) (Running))
    (0Bit (()) (Set even) (Running))
    (Last (()) (Print "Error!") (Initial))
  )
  (Running (1Bit ((IsOdd?) (Set even) (Running))
    ((IsEven?) (Set odd) (Running))
  )
    (0Bit (()) (Running))
  )
  (Last ((IsOdd?) (Print "Good!") (Done))
    ((IsEven?) (Print "Bad!") (Done))
  )
)
(Done ()))
  
```

Figure 19

```

(LogicName
  (StateName
    (EventName
      ((Predicate)
        (ActionName ())
        (ActionName (ParamSpec,...))
        (StateName)
      )
      (()) (ActionName (ParamSpec,...))
        (ActionName (ParamSpec,...))
        (StateName)
      )
    )
    (EventName
      ((Predicate)
        (ActionName (ParamSpec,...))
        (ActionName (ParamSpec,...))
        (StateName)
      )
      (()) (ActionName (ParamSpec,...))
        (ActionName (ParamSpec,...))
        (StateName)
      )
    )
  )
  (StateName
    (EventName
      ((Predicate)
        (ActionName (ParamSpec,...))
        (ActionName (ParamSpec,...))
        (StateName)
      )
    )
  )
)

```

Figure 20

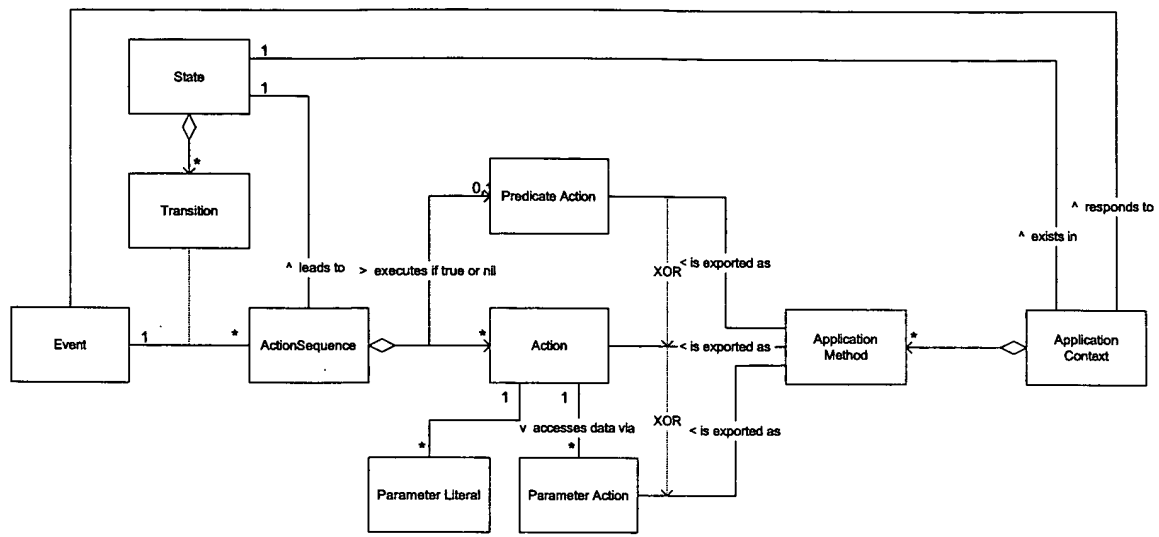


Figure 21

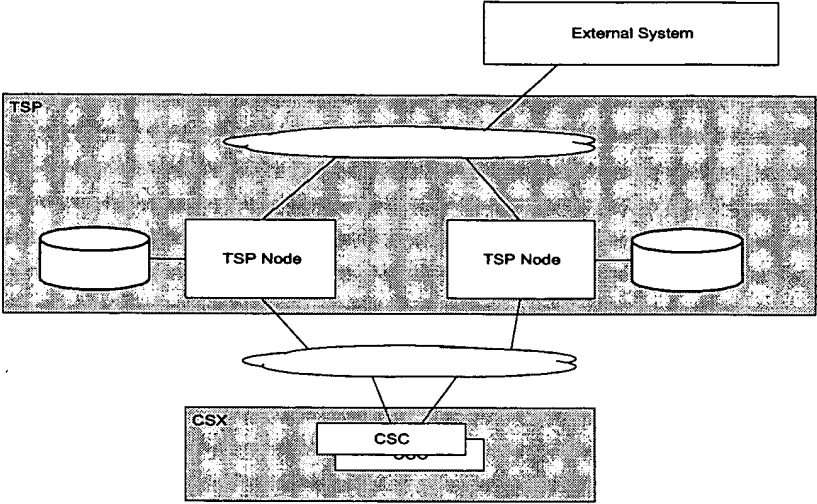


Figure 22

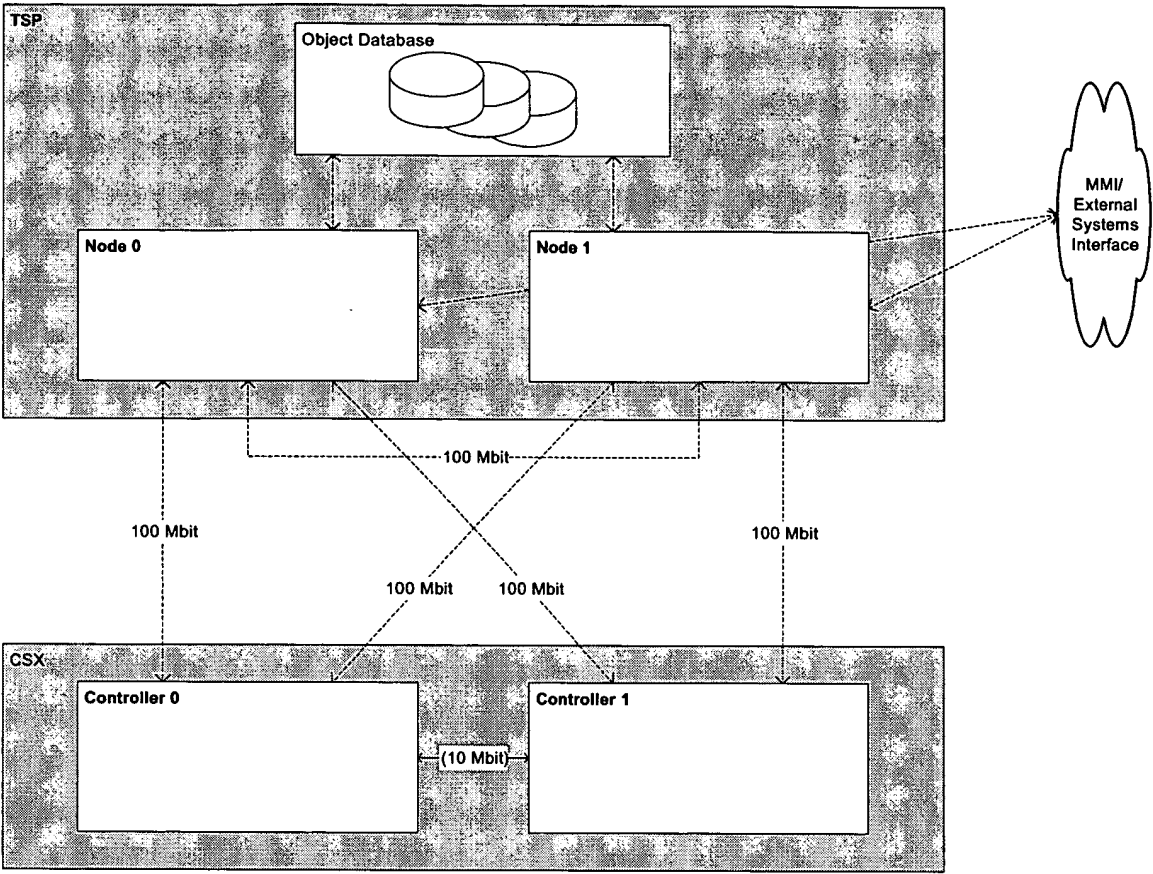


Figure 23

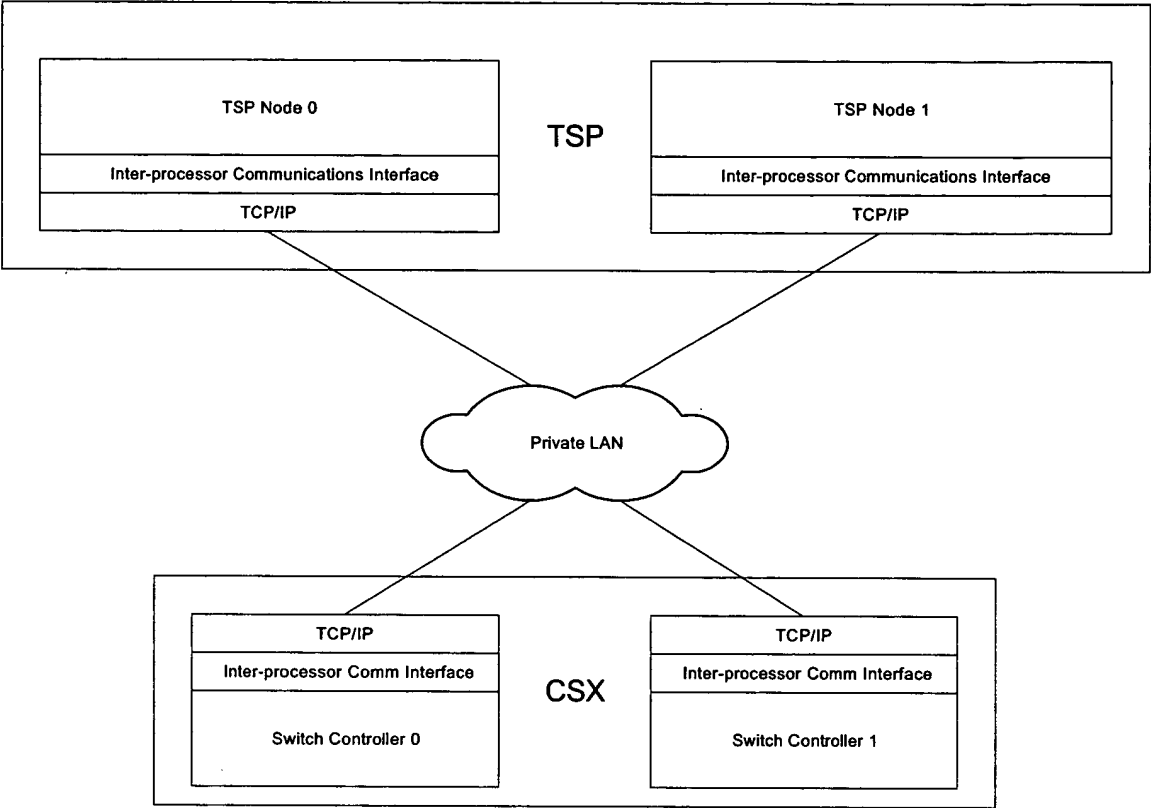


Figure 24

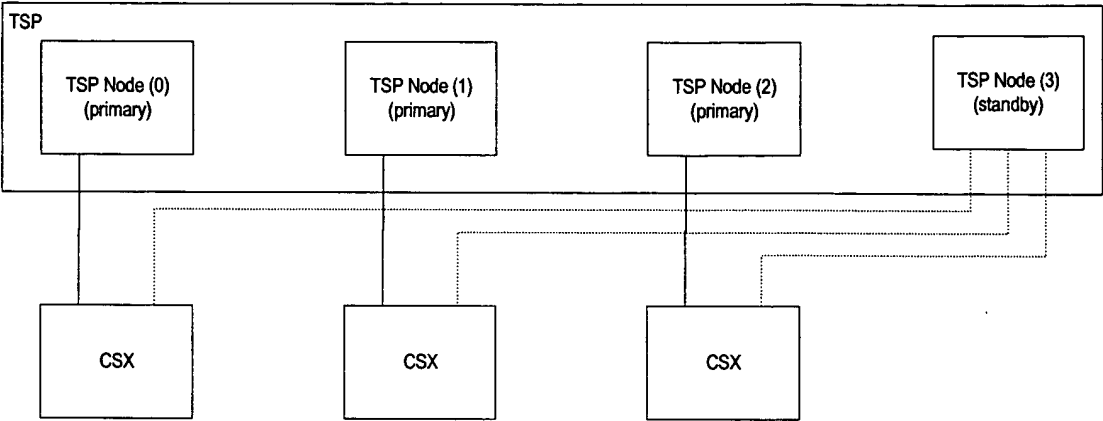


Figure 25

Figure 25 is a block diagram of a TSP system. The TSP system includes four TSP nodes: TSP Node (0) (primary), TSP Node (1) (primary), TSP Node (2) (primary), and TSP Node (3) (standby). The TSP system also includes three CSX units. TSP Node (0) is connected to CSX. TSP Node (1) is connected to CSX. TSP Node (2) is connected to CSX. TSP Node (3) is connected to CSX. The CSX units are connected to a common bus. The bus is connected to TSP Node (0), TSP Node (1), TSP Node (2), and TSP Node (3).

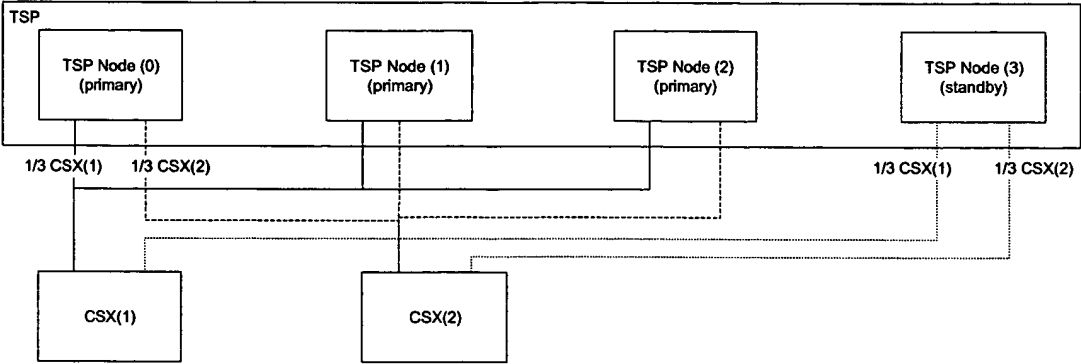


Figure 26

Copyright © 2000 by Lockheed Martin Corporation

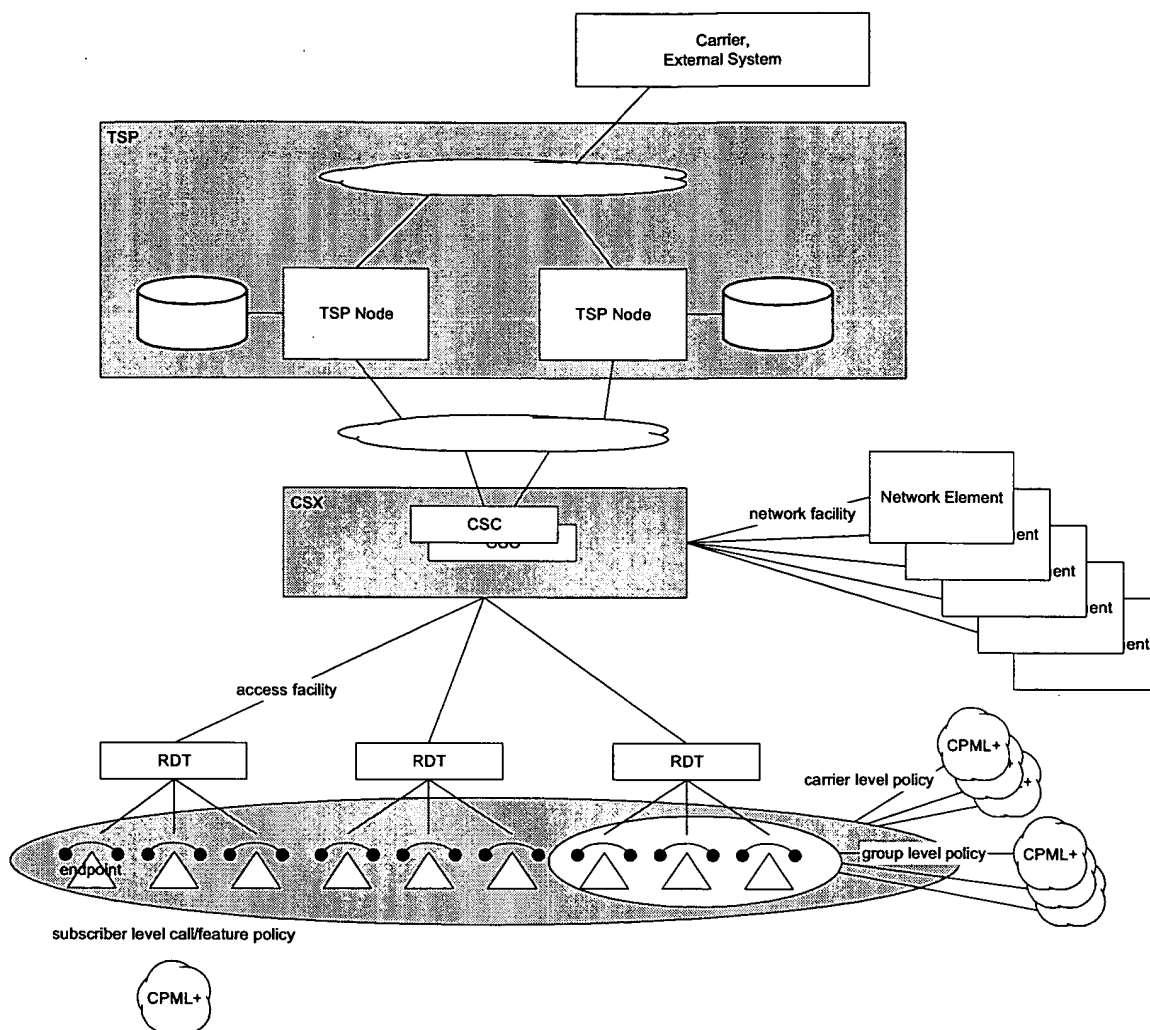


Figure 27

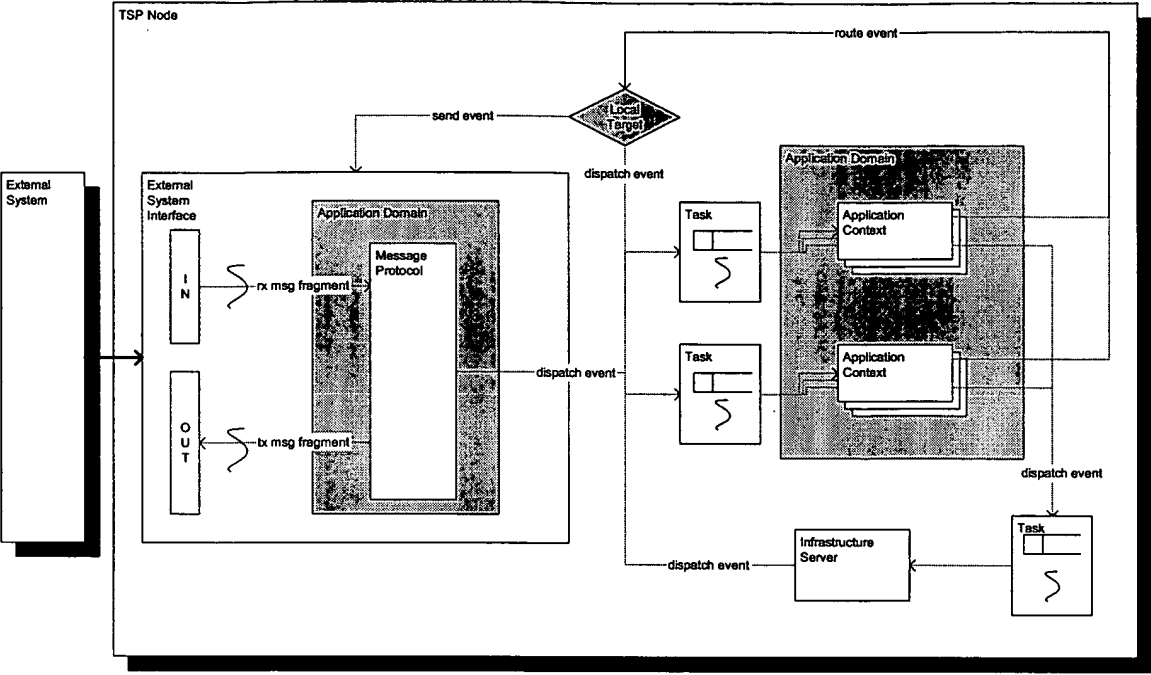


Figure 28A

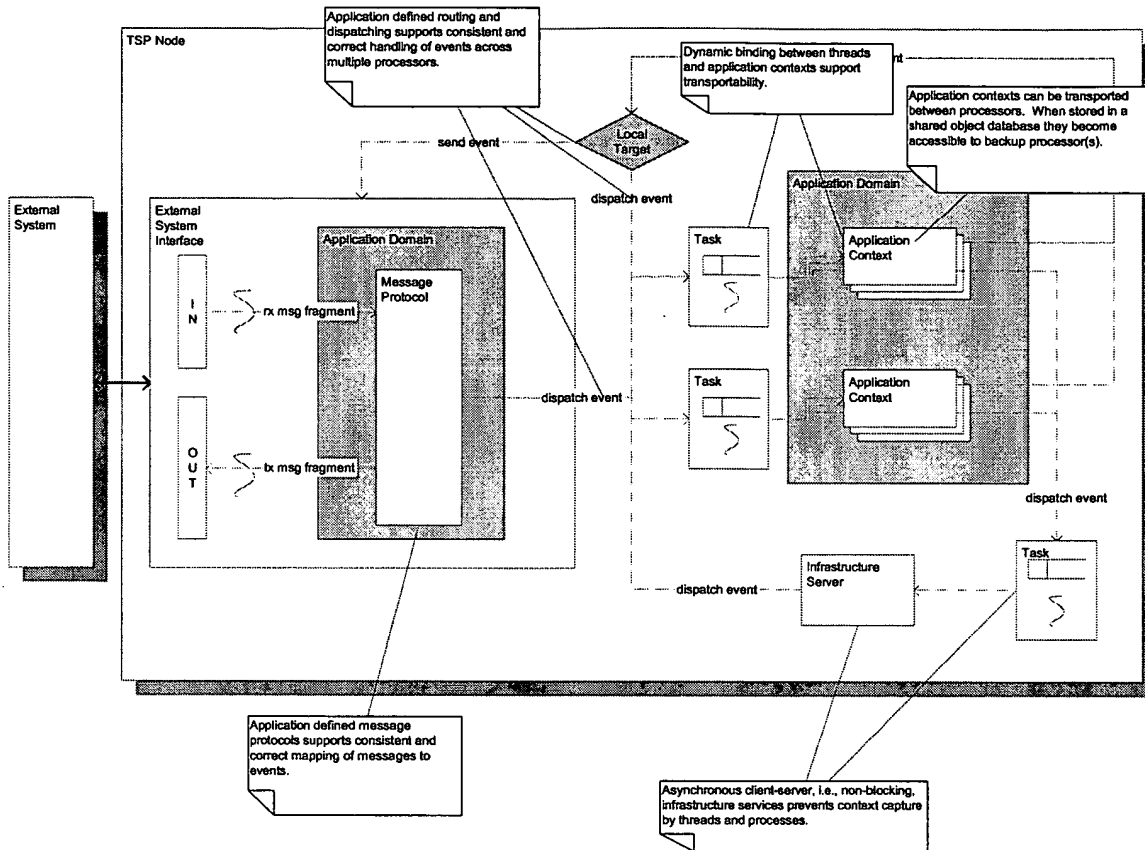


Figure 28B

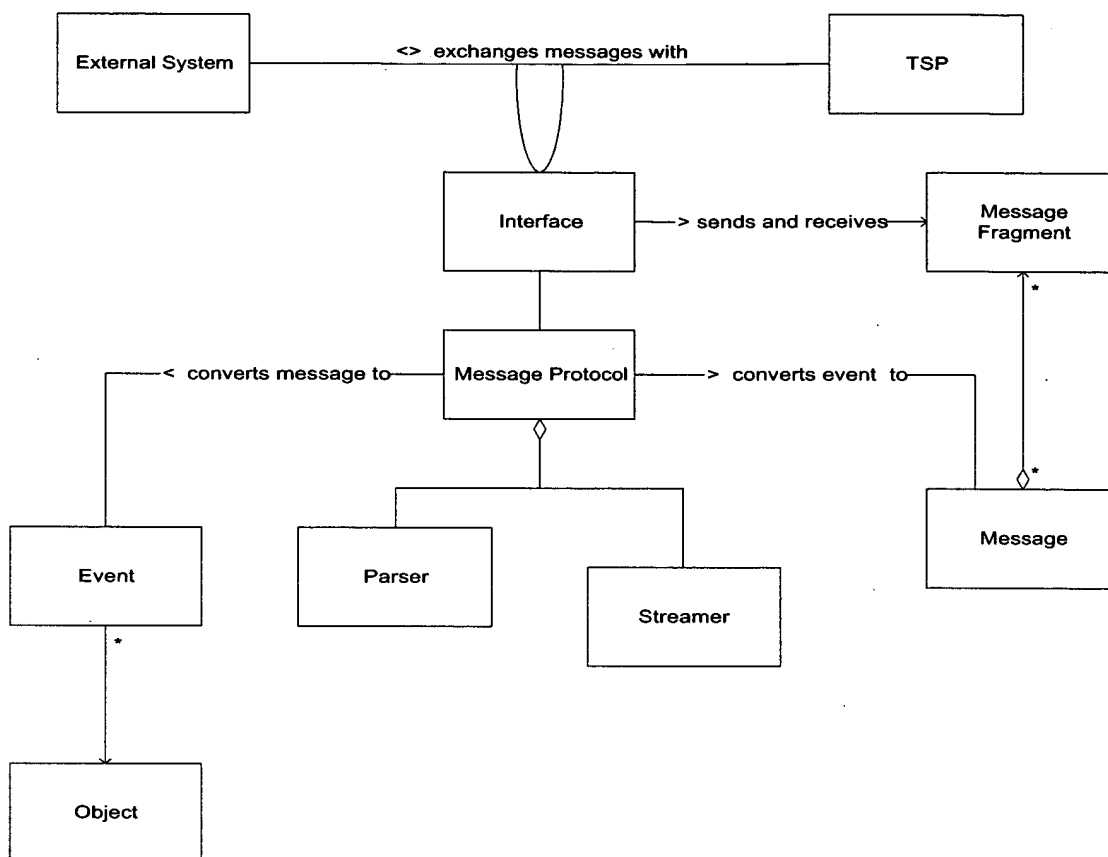


Figure 29

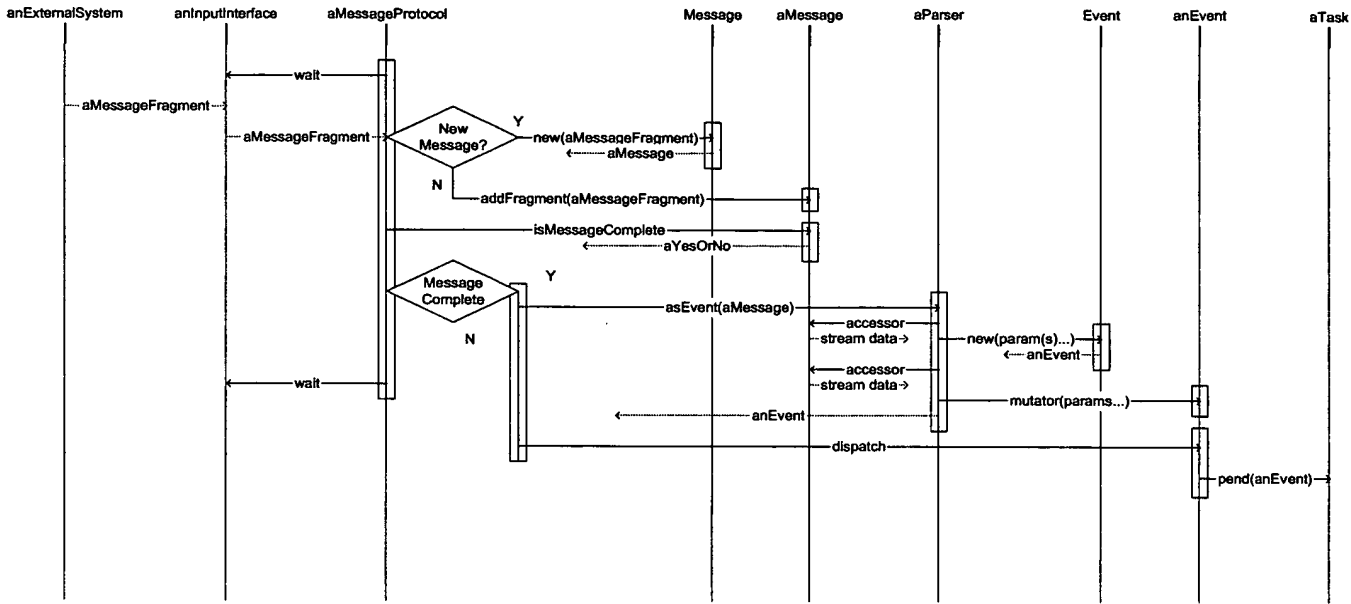


Figure 30A

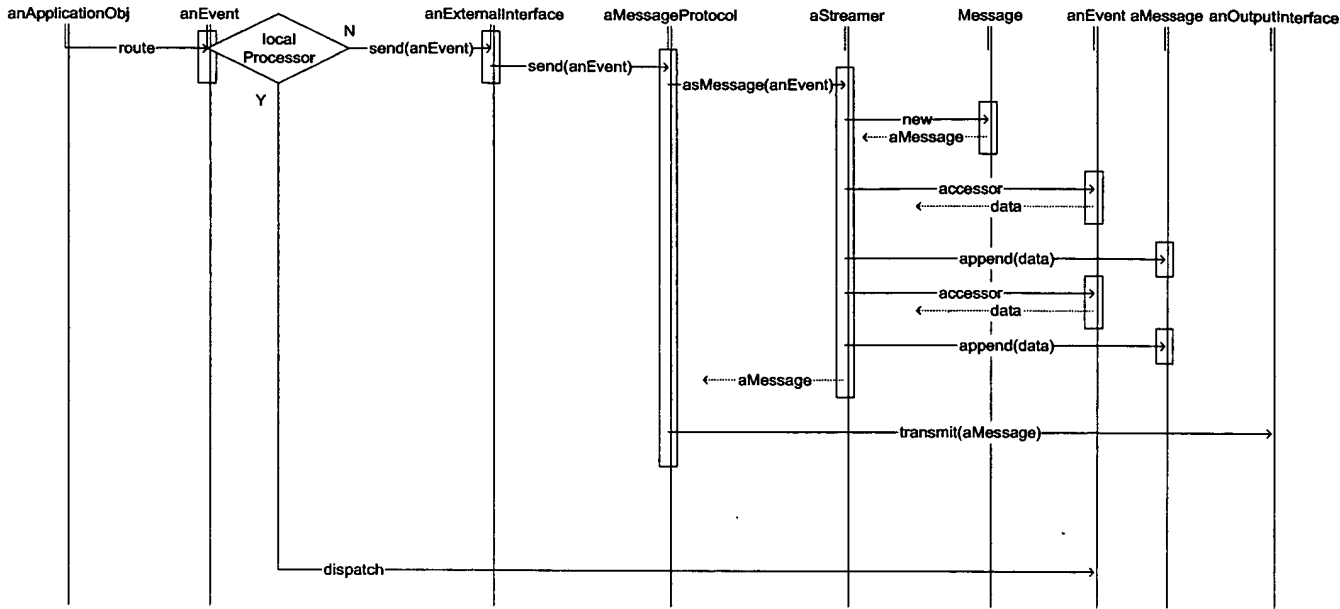


Figure 30B

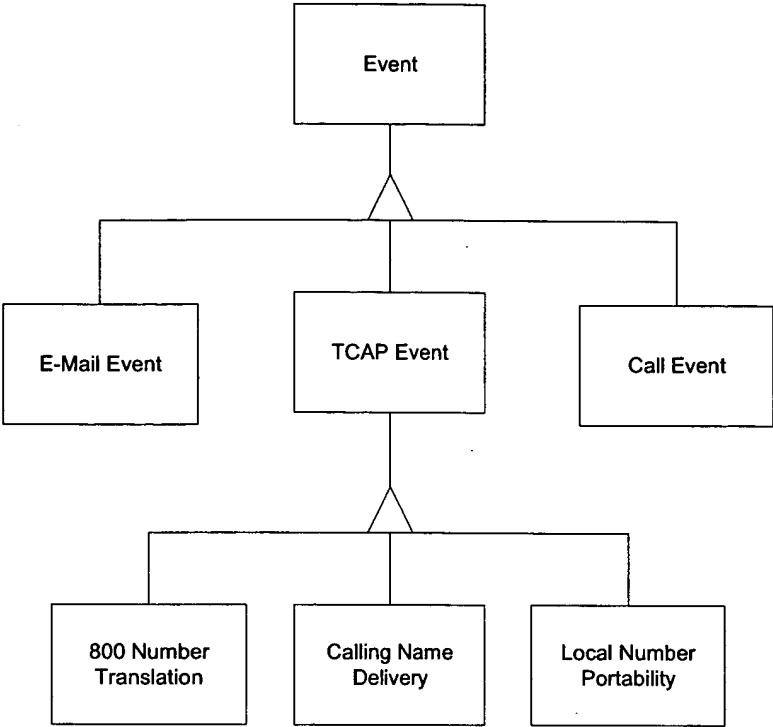


Figure 31

TCAP Event " 04452950

Call/Feature Policy

Definition	Describes call and feature processing behavior.
Native Format	ASCII based markup (CPML, CPML+) for external usage and maintenance. Object(s) for internal processing.
Source/Authority	Service maintenance and provisioning; the TSP/CSX product provides standardized call and class 5 feature definitions. Service Creation Environment (tool?) provides capability to create new or modify existing call and/or feature policies.
Value Initiation Frequency (Low)	Assuming that most policies are defined at carrier or group levels, new call and feature policies with the introduction of new group level call and features types. This frequency is less than the subscriber provisioning frequency. For individual level call and feature types, call and feature policies may be introduced coincident with the provisioning of new subscribers.
Value Change Frequency (Low to Moderate)	In general, call and feature logic elements change infrequently—when call or feature logic is modified or upgraded. This frequency is less than the subscriber provisioning frequency. Call and feature parameter elements, e.g., call forwarding destination number, may change at or above the subscriber provisioning frequency. Some parameter elements may change as much as hourly.
Value Access Frequency (High)	Call and feature policies, including logic and parameter elements, are accessed with each call.
Schema Change Frequency (Low)	Call and feature policy schemas define the structure with which calls and call features are described. Once mature, the schema for defining calls and features should change very infrequently; only as often as needed to upgrade call type and feature specification capabilities.
Consumer(s)	Call and feature processing.
Consumer Format	Object(s)
Replications and Sharing	TSP nodes share call and feature processing specifications.
Scope	System, Group, and Individual Subscriber
Volume	Group and system level logic elements have few instances. Individual level logic elements are coincident with subscriber volumes. Parameter element volumes are a function of the number of parameterized features in combination with the subscriber population size.

Figure 32A

TSP/CSX "046330"

Route

Definition	Describes transmission paths between a network element and its associated endpoints and other network elements and the characteristics of those paths.
Native Format	
Source/Authority	OAM&P
Value Initiation Frequency (Low)	New route entities are introduced when new transmission paths are provisioned and when new transmission path characteristics are provisioned.
Value Change Frequency (Low)	Since routes are related to physical equipment and transmission facilities, routes are relatively static.
Value Access Frequency (High)	Route data is accessed for each call.
Schema Change Frequency (Low)	
Consumer(s)	Call processing.
Consumer Format	
Replications and Sharing	Multiple TSP nodes share route data entities.
Scope	
Volume	Route volumes are a function of the count of endpoints, associated network elements, and transmission path characteristics.

Figure 32B

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Introduction

Endpoint/Subscriber

Definition	Describes endpoint devices (within scope of TSP/CSX), the configuration of those devices, subscribers associated with endpoint devices, and associates endpoint(s)/subscriber(s) with call and feature policies.
Native Format	
Source/Authority	Subscriber care (subscriber provisioning and maintenance).
Value Initiation Frequency (Low)	Endpoint/subscriber instances are initiated as new subscribers are added to the carrier's subscriber base. Call and feature policy associations are initiated as new call types and features are deployed and as subscribers subscribe to different services.
Value Change Frequency (Low)	Value changes occur as subscribers modify their calling and/or feature parameters.
Value Access Frequency (High)	Endpoint/subscriber data is accessed with each call.
Schema Change Frequency (Low to Moderate)	Endpoint schema changes only with software product upgrades. Subscriber schema may be extended through introduction of new features.
Consumer(s)	Call and Feature processing.
Consumer Format	Object
Replications and Sharing	Multiple TSP nodes share Endpoint/subscriber data.
Scope	
Volume	Endpoint/subscriber volumes equal the carrier's subscriber population.

Figure 32C

TSP/CSX "Object"

Call/Feature State

Definition	Describes the current state of calls and/or call features.
Native Format	Object
Source/Authority	Call and Feature Processing; call and feature state data is generated and maintained for each call and/or feature.
Value Initiation Frequency (High)	Call state instances are initiated with each call. Feature state instances are initiated as needed based on call level events.
Value Change Frequency (High)	Call and feature state changes occur in response to events throughout the life of the associated call and/or feature(s).
Value Access Frequency (High)	Call and feature state are accessed in order to service events throughout the life of the associated call and/or feature(s).
Schema Change Frequency (Low)	Call and feature state objects a combination of native application objects and instantiations of call and feature policy schemas. Native object schemas change only with product software upgrades. Call and feature policy schema changes are addressed elsewhere.
Consumer(s)	Call and feature processing.
Consumer Format	Object
Replications and Sharing	Call and feature states are replicated in support of fault tolerance capabilities.
Scope	
Volume	Call and feature volumes are a function of the subscriber population combined with the subscriber's calling frequency constrained by transmission capabilities.

Figure 32D

Equipment/Facility

Definition	Describes an equipment item or a transmission facility, and the configuration of that equipment item or transmission facility. Equipment items include processor devices, remote data terminals, intelligent peripherals, etc. Transmission facilities include network facilities, which connect a CSX to an external network element, and access facilities, which provide endpoints with access to the carrier's network.
Native Format	MIB?
Source/Authority	OAM&P
Value Initiation Frequency (Low)	New equipment descriptions are introduced when the carrier adds new equipment components. New network facilities are introduced when the carrier adds new transmission facilities.
Value Change Frequency (Low)	Changes in equipment and transmission facility descriptions and configurations are rare once provisioned and stable.
Value Access Frequency (Low)	Equipment and transmission facility descriptions and configurations are accessed only during system initialization and re-boots.
Schema Change Frequency (Low)	Equipment and transmission facility schemas change only support for new equipment and/or transmission types is added to the product.
Consumer(s)	System initialization and OA&P processes.
Consumer Format	
Replications and Sharing	TSP nodes share some of the equipment and transmission facility description and configuration data. TSP and CSX elements share certain categories of equipment and transmission facility descriptions and configurations.
Scope	
Volume	This is a function of the count of equipment items and transmission facilities.

Figure 32E

Equipment/Facility State

Definition	Describes the present state of an equipment item or a transmission facility.
Native Format	MIB?
Source/Authority	OA&M processes, certain aspects of call processing. NMS may command state changes.
Value Initiation Frequency (Low)	Equipment and facility states are initiated during system initialization and re-boots.
Value Change Frequency (Moderate to High)	Certain types of equipment and transmission facilities change state frequently. Other types change state with only moderate frequency. Aggregate equipment and facility states change with less frequency than individual components.
Value Access Frequency (Varies from Low to High)	In general, this data is accessed at NMS polling intervals. State data that contributes to statistics may be sampled at frequent intervals.
Schema Change Frequency (Low)	Equipment and facility state schemas change only with product upgrades.
Consumer(s)	NMS
Consumer Format	MIB?
Replications and Sharing	Multiple TSP nodes may share certain state elements. Certain equipment and facility state elements may be replicated for redundancy support.
Scope	
Volume	This is a function of the count of equipment items and transmission facilities.

Figure 32F

Equipment/Facility Statistics

Definition	Describes a usage or event occurrence history with respect to a particular equipment item or facility.
Native Format	MIB?
Source/Authority	OA&M processes, certain aspects of call processing.
Value Initiation Frequency (Low)	Values are initiated during system initialization and re-boots.
Value Change Frequency (Moderate to High)	Statistics on directly measured attributes change with the frequency of related events. Statistics on sampled attributes change with the sampling frequency.
Value Access Frequency (Low to Moderate)	These values are accessed at collection and polling intervals.
Schema Change Frequency (Low)	Statistic schema changes occur only with product upgrades.
Consumer(s)	NMS, OAM&P
Consumer Format	SNMP Messages, ASCII based markup logs
Replications and Sharing	
Scope	
Volume	Statistics volume is a function of measurement method, measurement intervals, and count of sampled entities.

Figure 32G

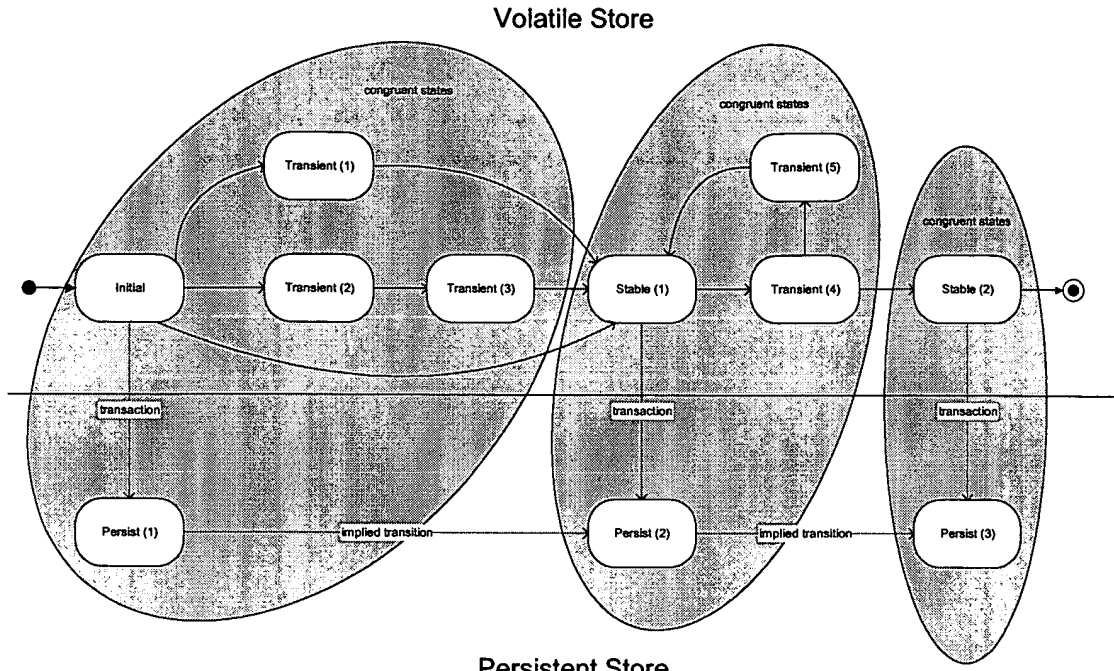
Figure 32G is a table titled "Equipment/Facility Statistics". The table has two columns: the first column lists various attributes and frequencies, and the second column provides descriptions or details for each. The attributes listed include Definition, Native Format, Source/Authority, Value Initiation Frequency (Low), Value Change Frequency (Moderate to High), Value Access Frequency (Low to Moderate), Schema Change Frequency (Low), Consumer(s), Consumer Format, Replications and Sharing, Scope, and Volume. The descriptions range from "Describes a usage or event occurrence history with respect to a particular equipment item or facility." to "Statistics volume is a function of measurement method, measurement intervals, and count of sampled entities."

Automated Message Accounting (AMA)

Definition	Describes call and feature usage characteristics relevant to call and feature billing.
Native Format	AMA data is packed binary coded decimal. Historically, AMA data is stored and/or transmitted in blocks according to a standard tape record format.
Source/Authority	Billing related processing; AMA records are generated from CDRs.
Value Initiation Frequency (Low)	AMA records are most likely generated according to an internal schedule, perhaps once or twice daily. AMA generation may occur on demand when polled by an external system. AMA or as specified by call and/or feature definitions to support real-time bill calculation/accounting.
Value Change Frequency (Static)	AMA records are static once generated.
Value Access Frequency (Low)	In general, AMA records are accessed only when passed to an external system for processing—under nominal circumstances this occurs once for each record. Additional accesses may occur to support recovery of an external processing exception.
Schema Change Frequency (Low)	New AMA schemas may be introduced with new service introductions. Existing AMA record schemas are defined by Telcordia standards and therefore change infrequently.
Consumer(s)	External bill processing system.
Consumer Format	AMA
Replications and Sharing	AMA data need not be replicated or shared among TSP processing nodes.
Scope	System
Volume	AMA volumes are a function of call/ feature volume.

Figure 32H

Figure 32I



Persistent Store

Figure 33

FIG. 33

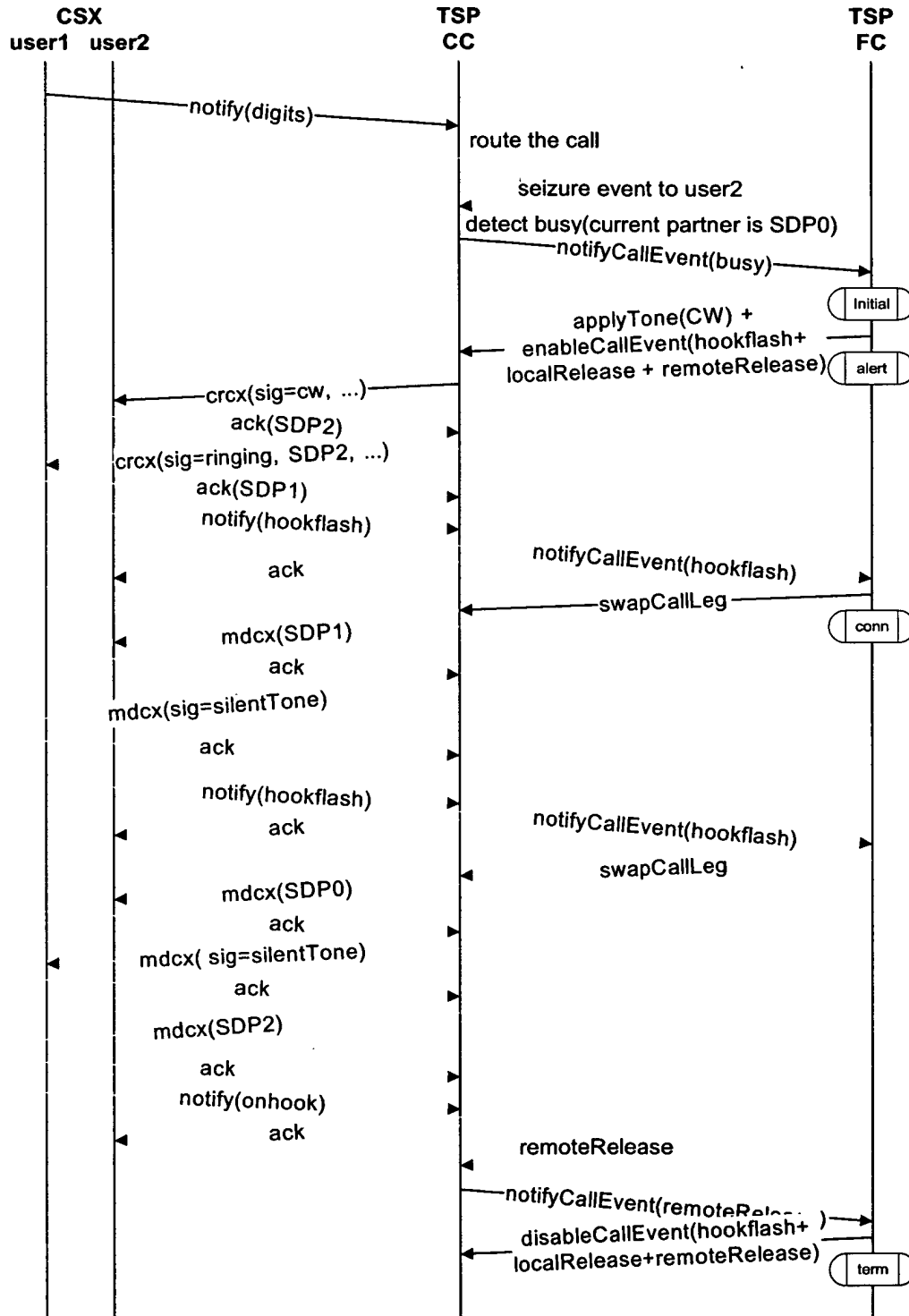
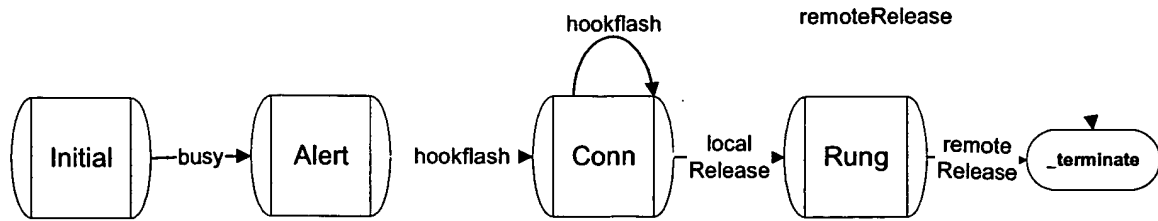


Figure 34



Call Waiting State Machine

Figure 35

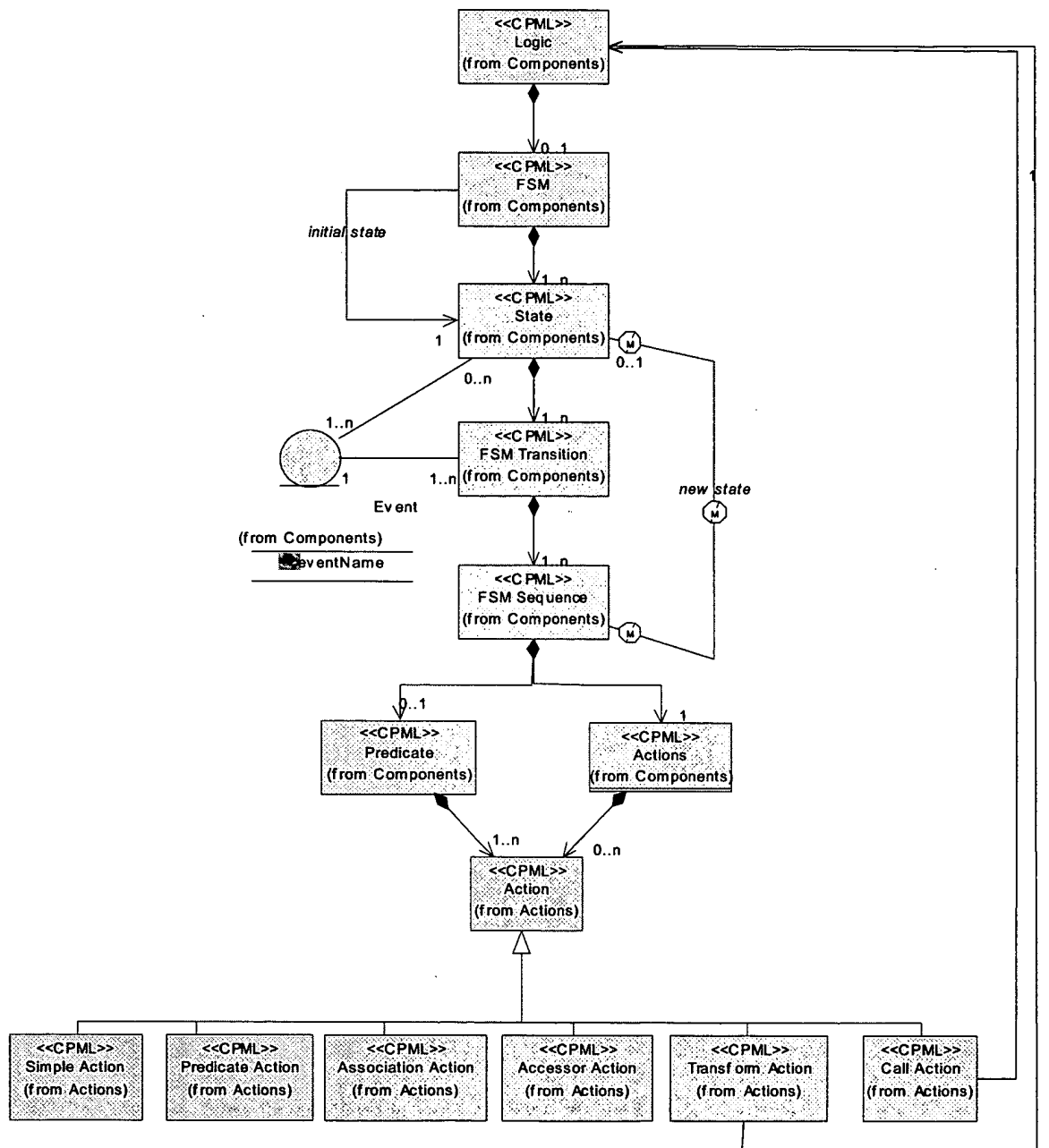


Figure 36A

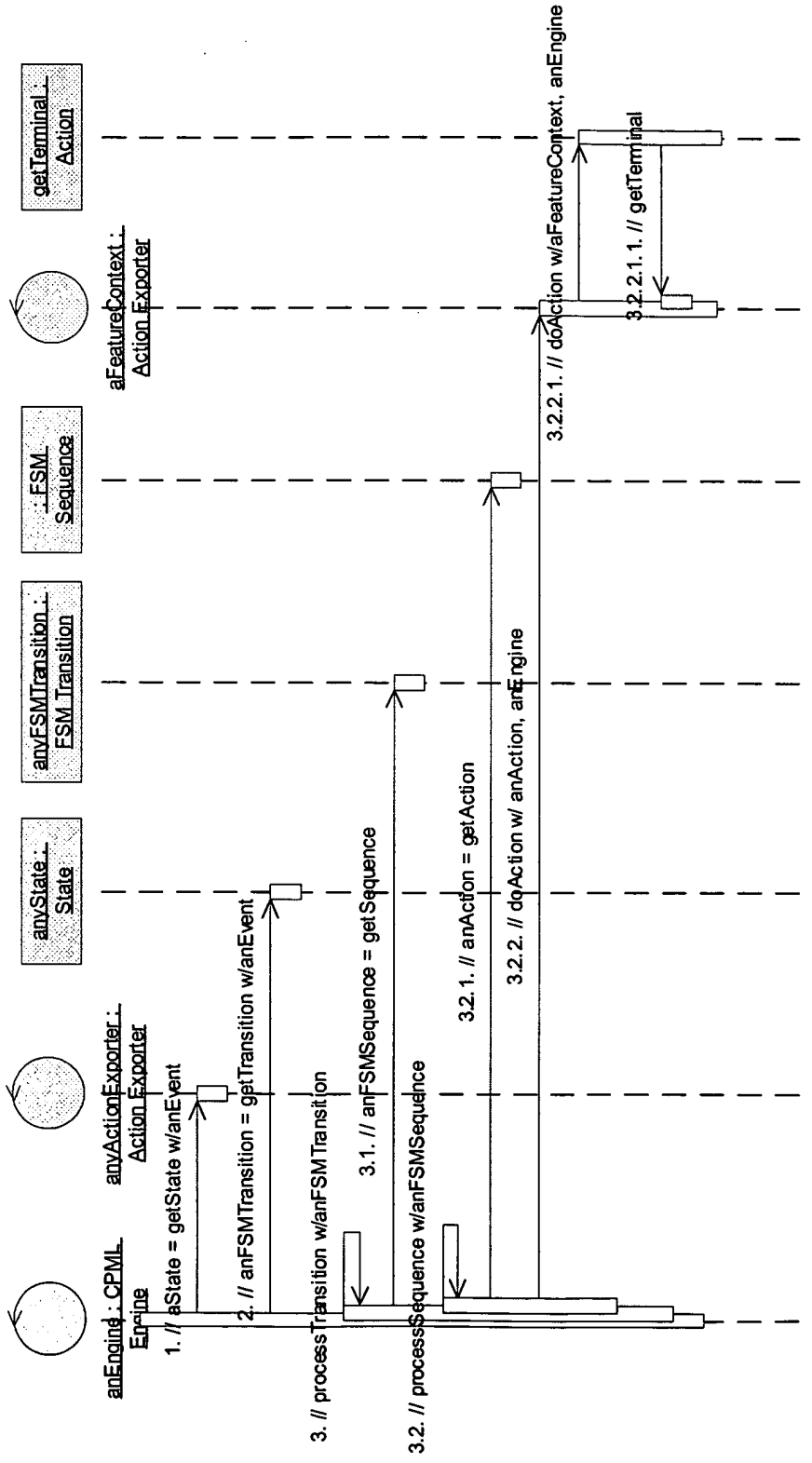


Figure 36B

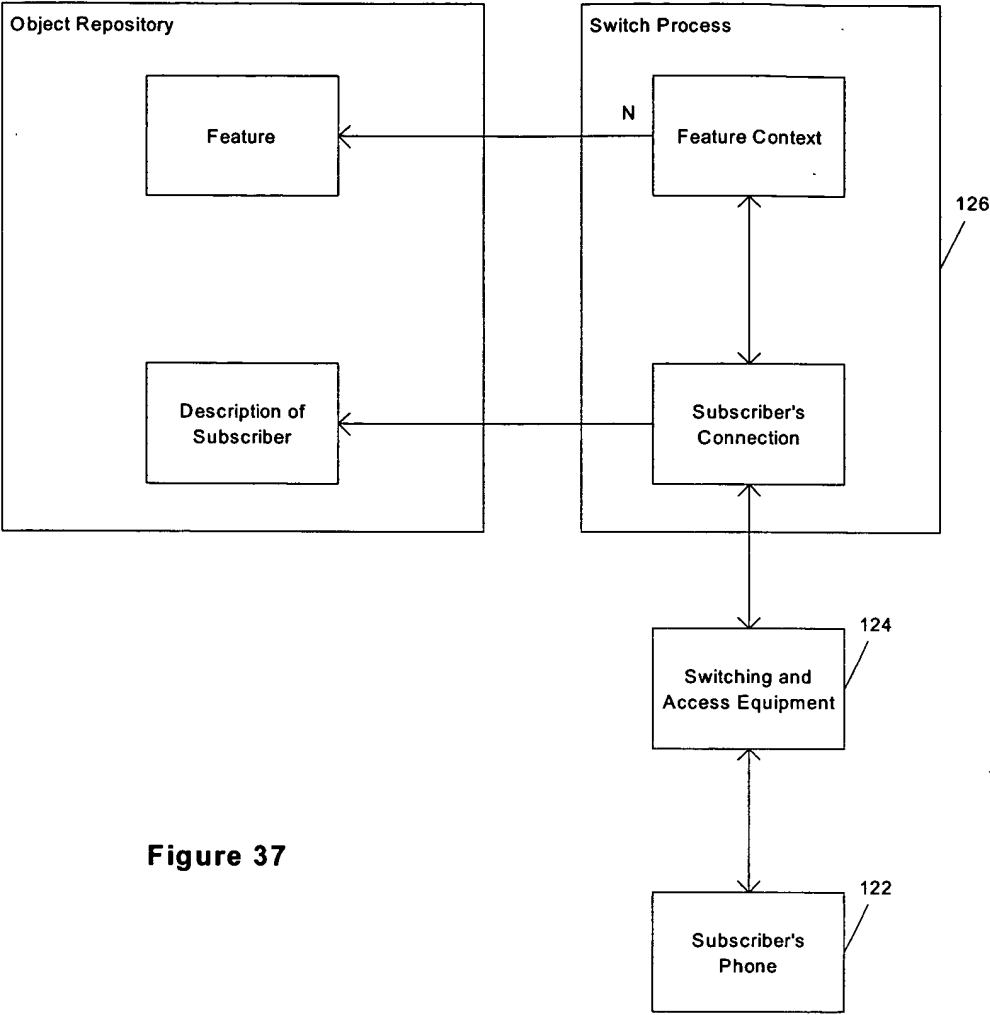


Figure 37

FIG. 37 is a block diagram of a system.

Example State Machine

```

<?xml version="1.0"?>
<DOCTYPE LOGIC SYSTEM "fsm.dtd">
<LOGIC Name="CallAuthorizationSvc">
  <FSM InitState="START">
    <STATE Name="START">
      <TRANSITION Name="T1_1" Event="START">
        <FSMSEQUENCE NextState="CALL_AUTHORIZATION_SVC_END">
          <ACTIONS>
            <ACTION Name="postInternalEvent">
              <LITERAL Name="EventLiteral" Value="Authorized"/>
            </ACTION>
          </ACTIONS>
        </FSMSEQUENCE>
      </TRANSITION>
    </STATE>
    <END_STATE Name="CALL_AUTHORIZATION_SVC_END"/>
  </FSM>
</LOGIC>

```

Figure 38

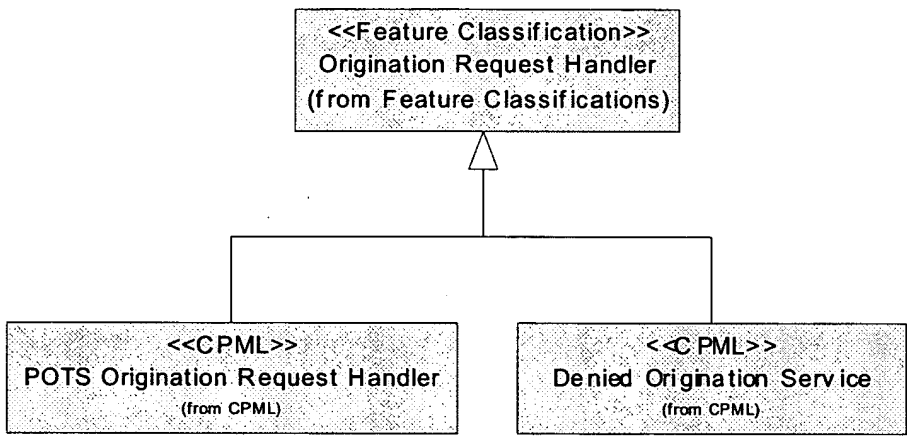


Figure 39

TOP SECRET

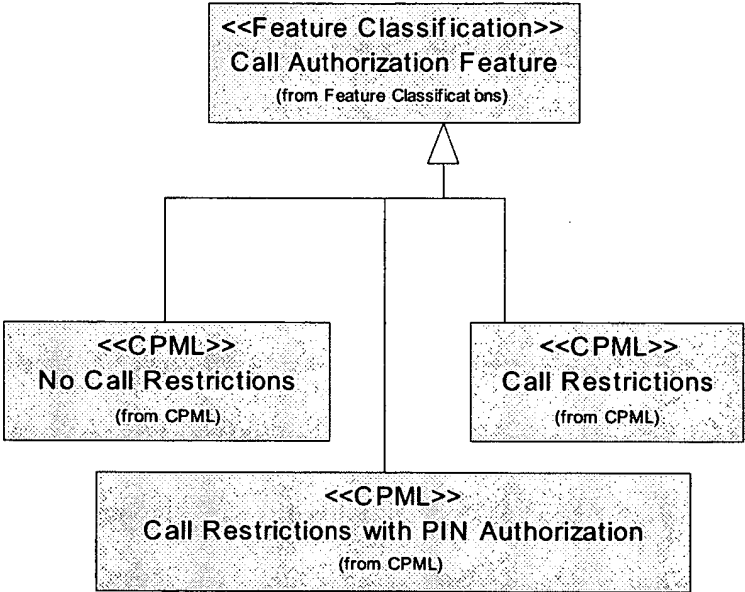


Figure 40

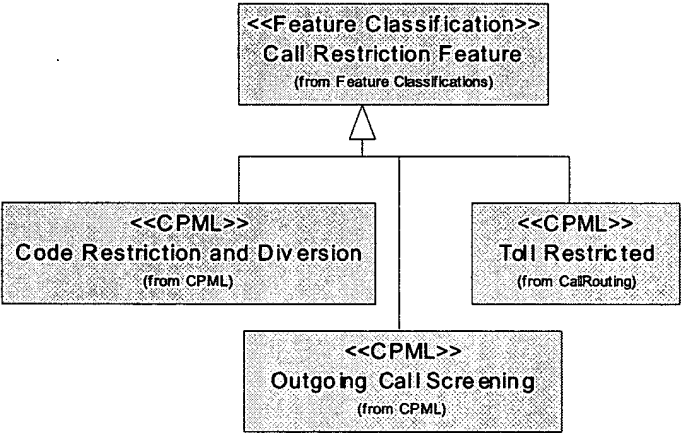
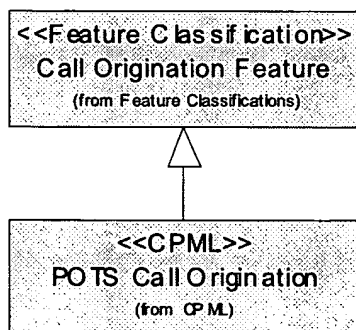


Figure 41

**Figure 42**

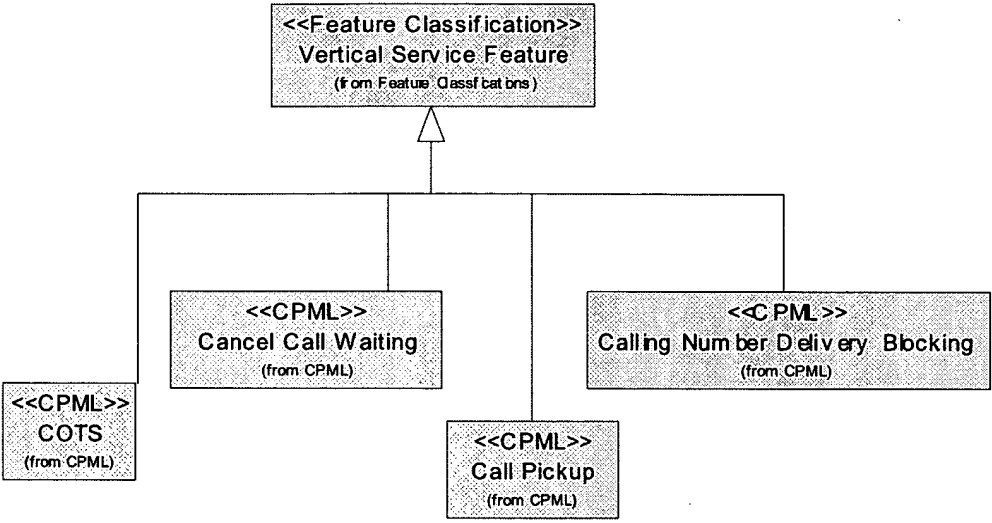
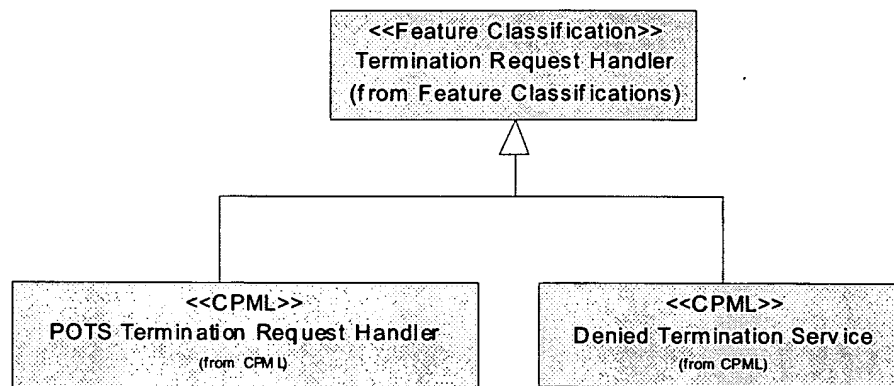


Figure 43

**Figure 44**

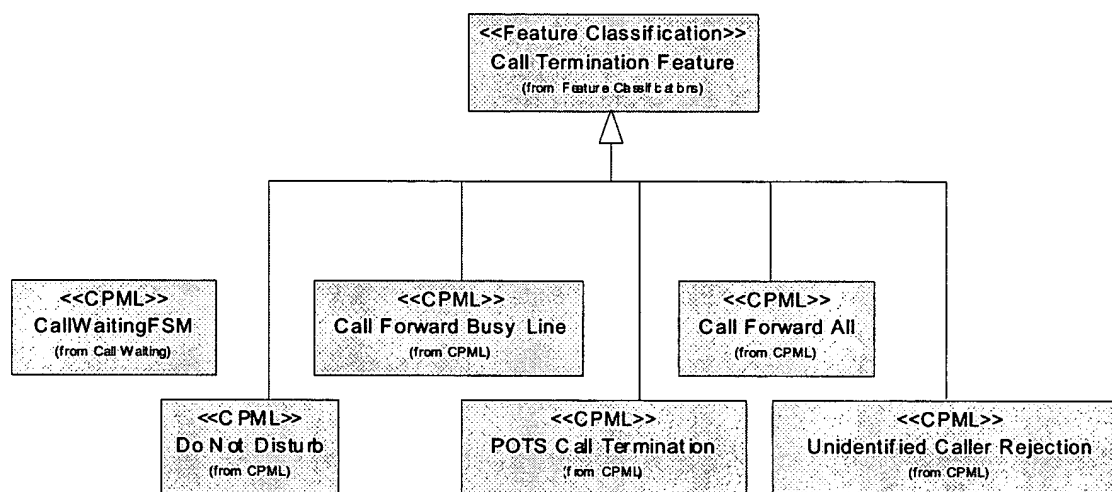


Figure 45

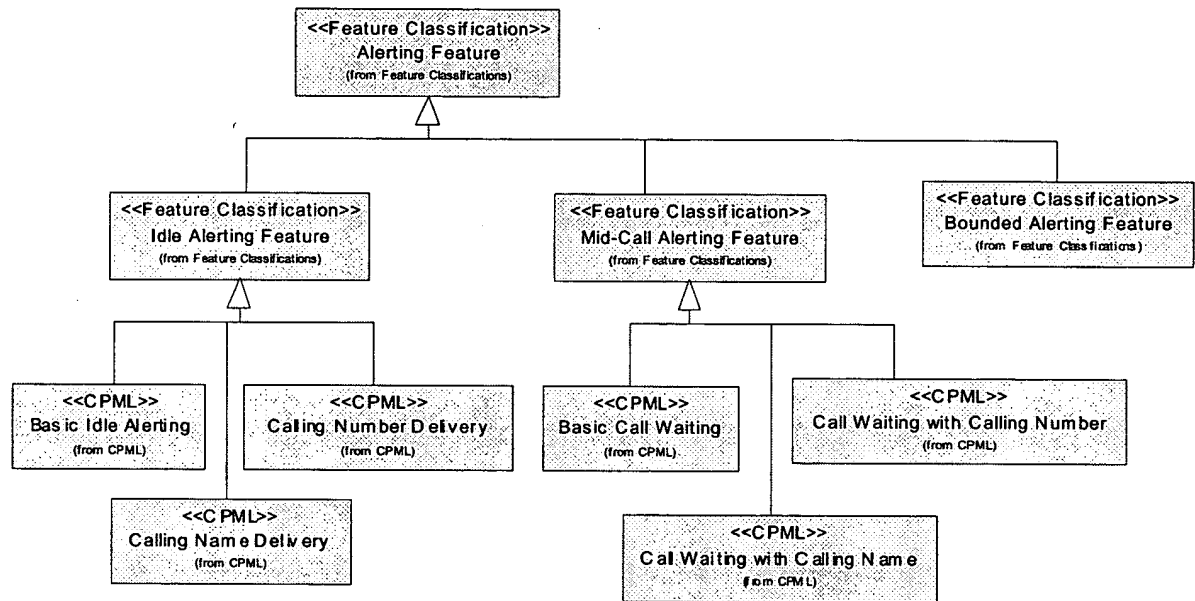


Figure 46

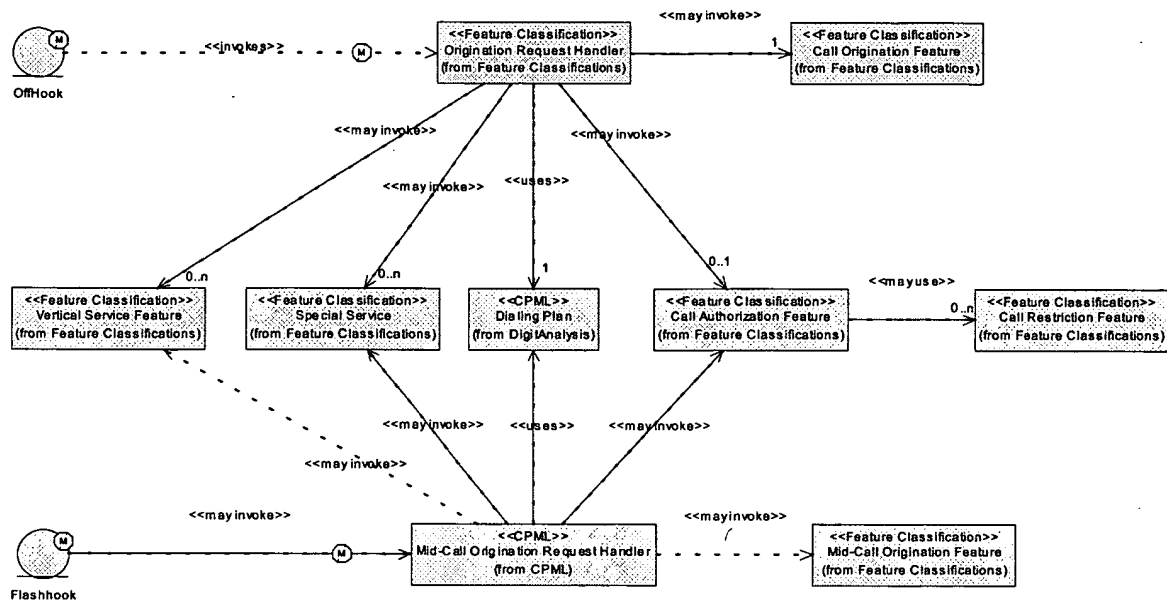


Figure 47

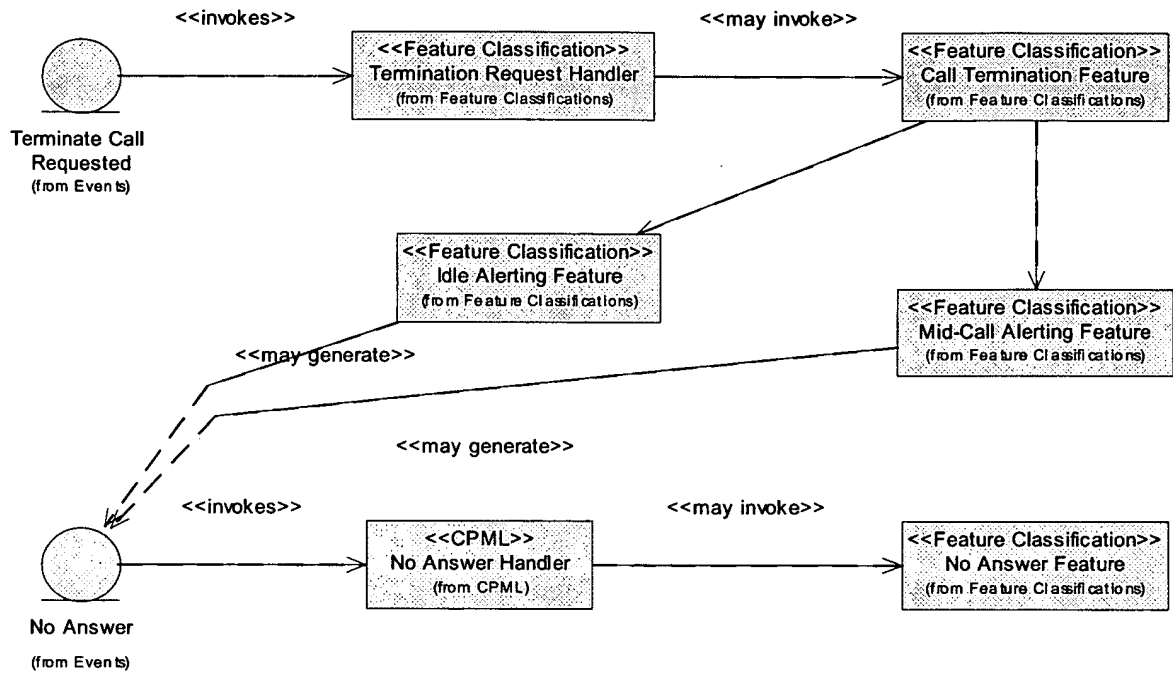


Figure 48

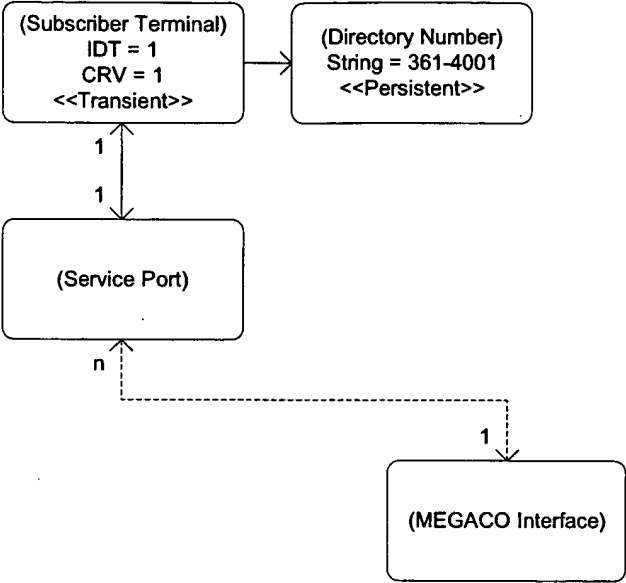


Figure 49A

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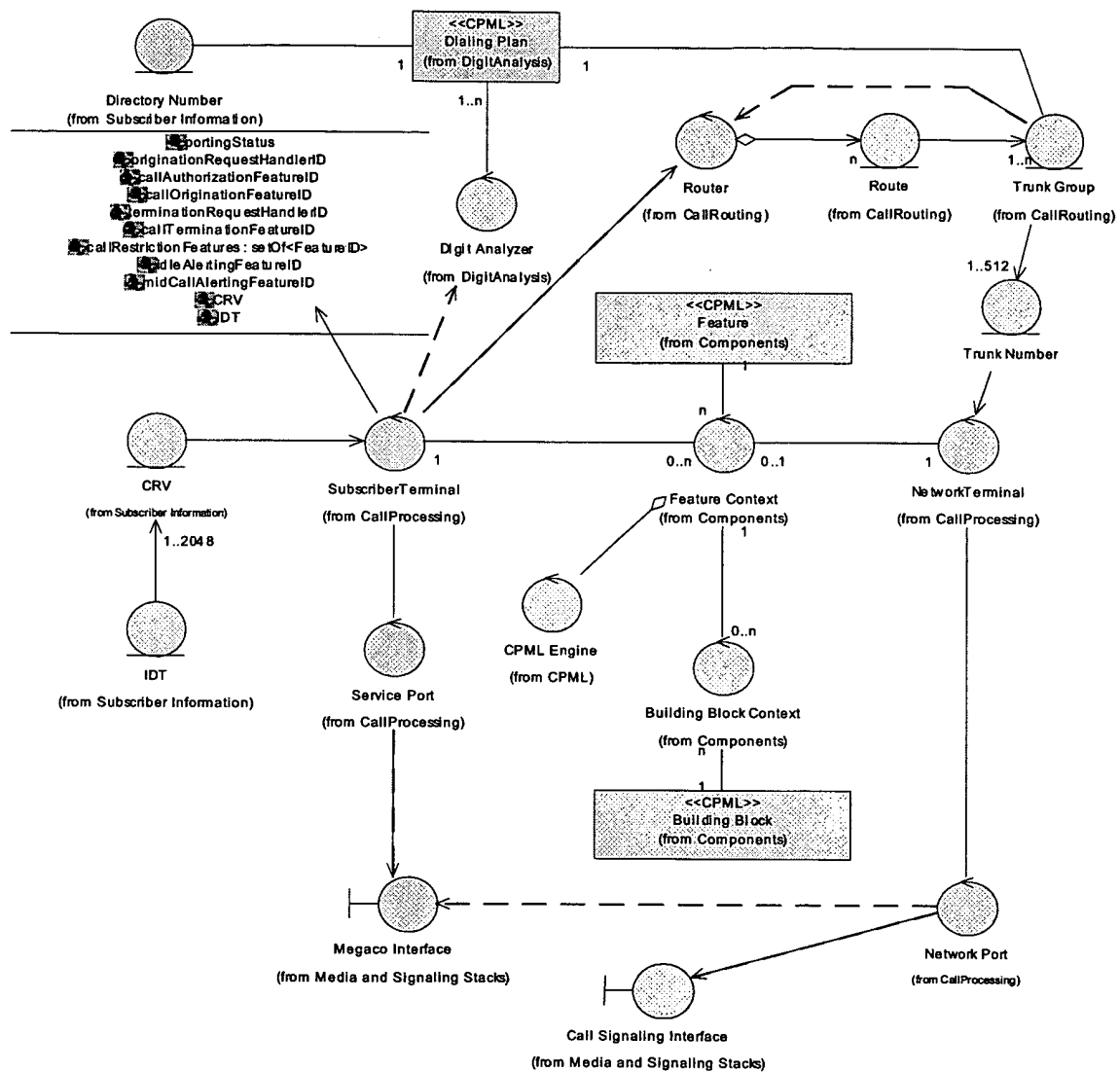


Figure 49B

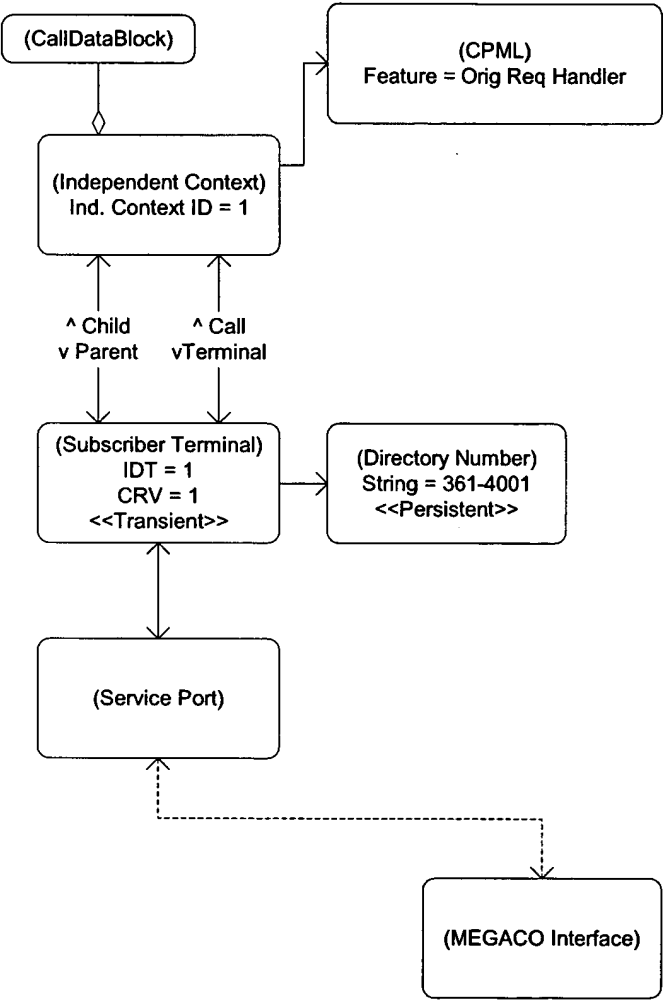


Figure 50

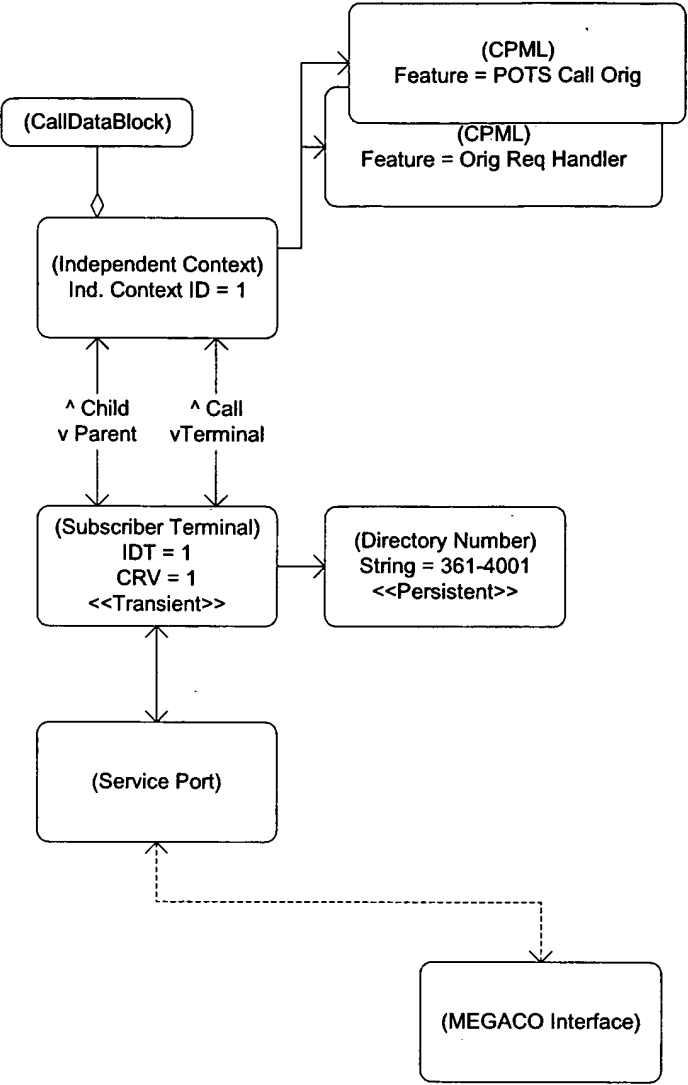


Figure 51

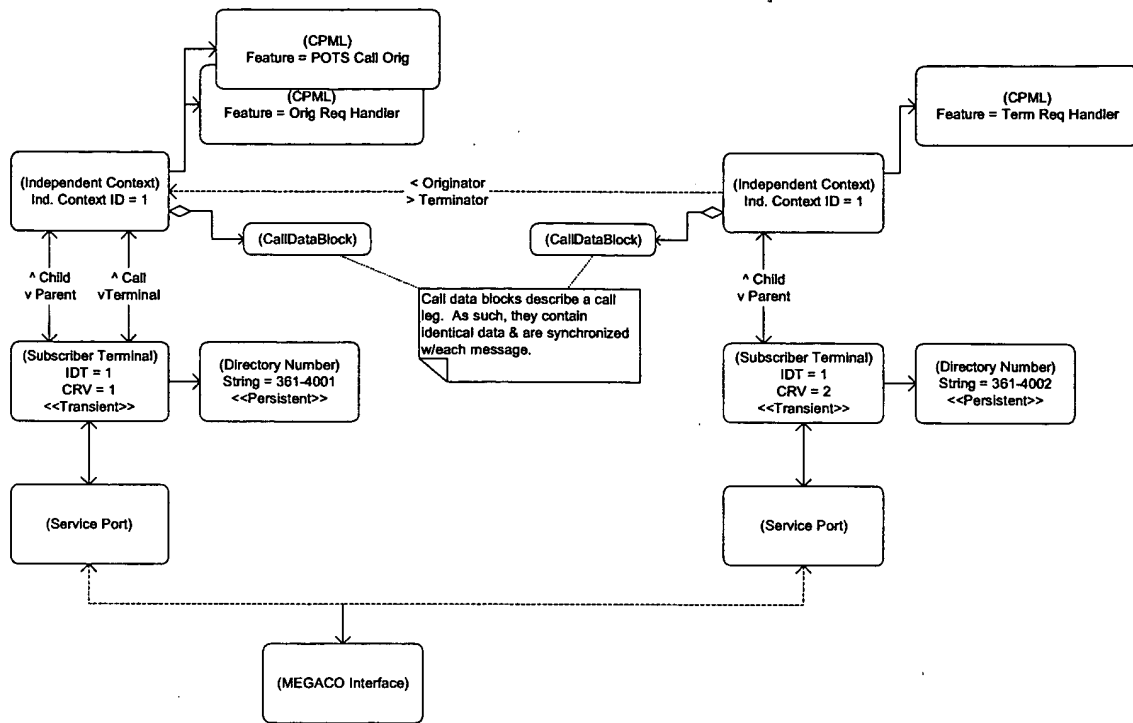


Figure 52

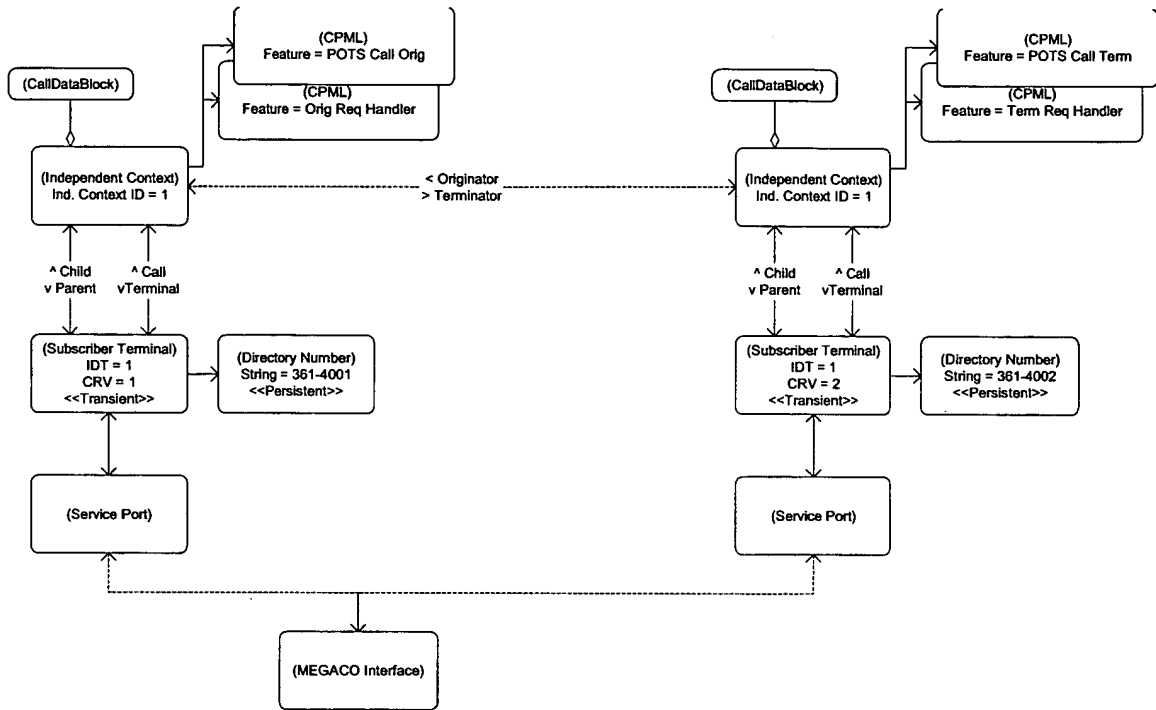
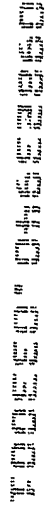


Figure 53

[illegible]

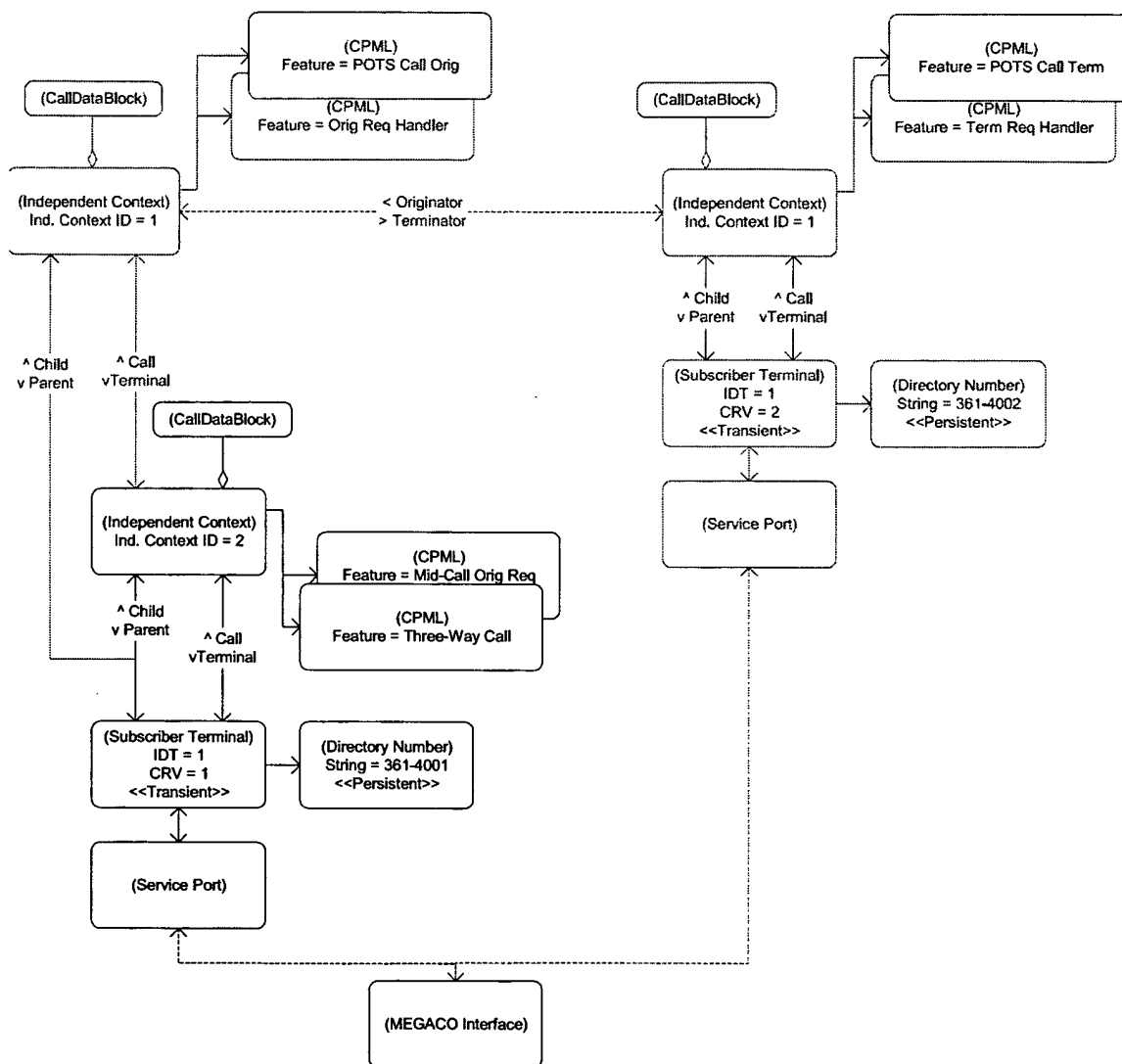


Figure 55

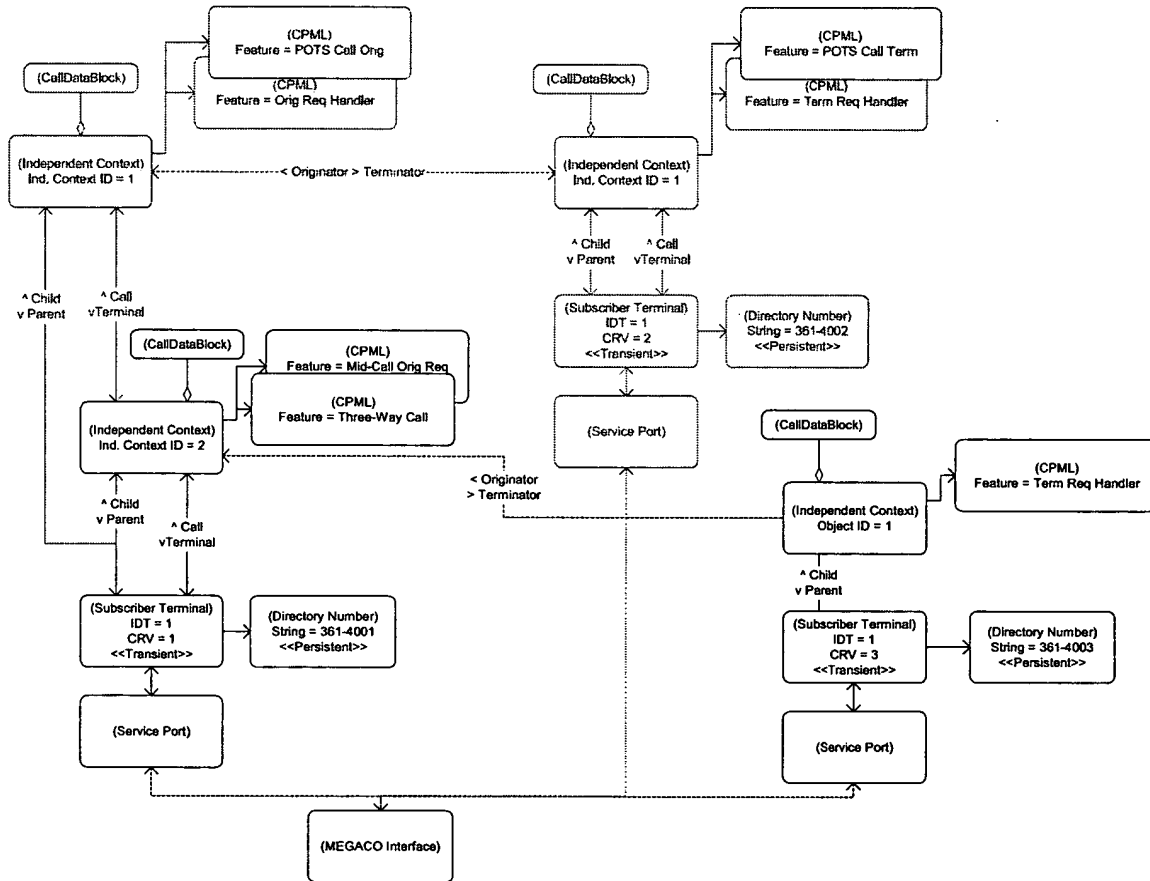


Figure 56

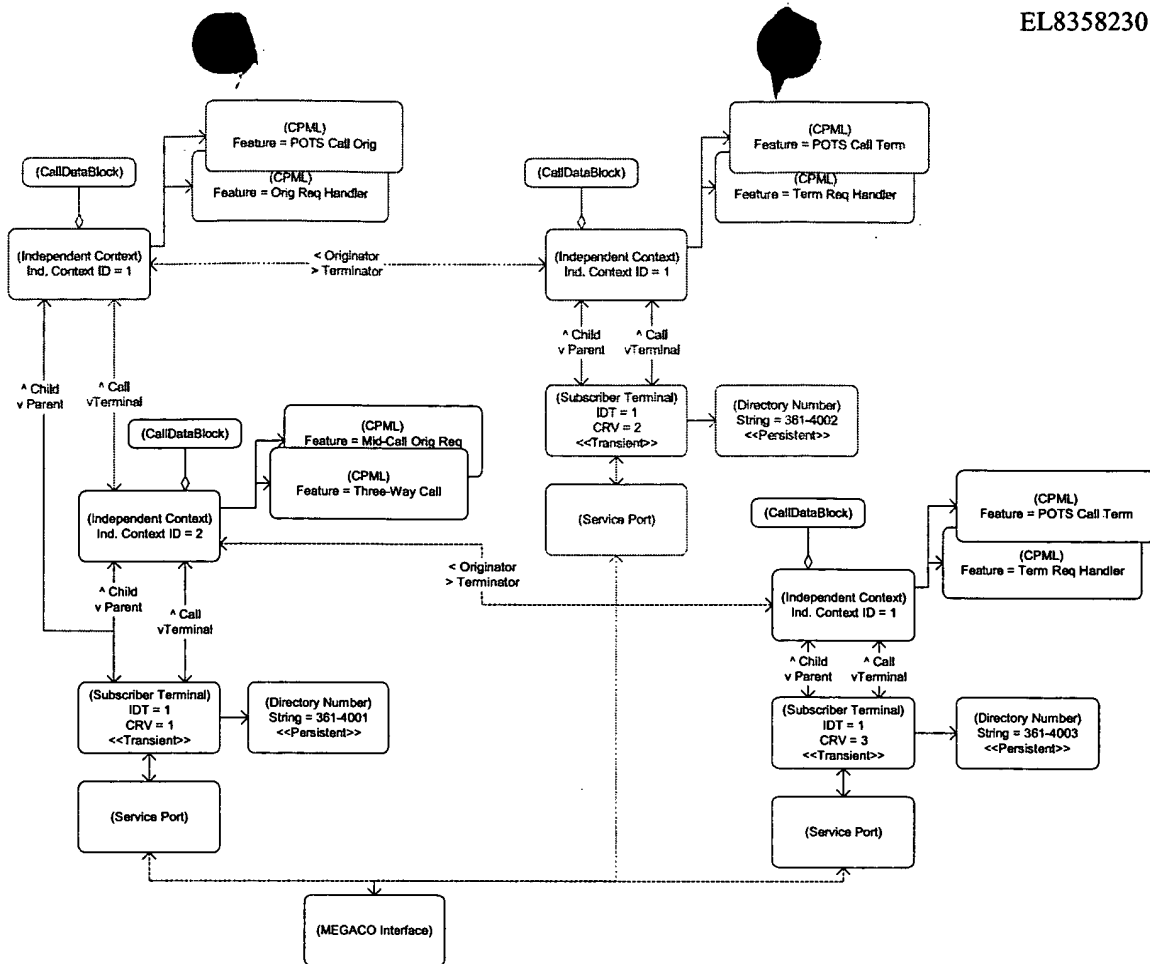


Figure 57

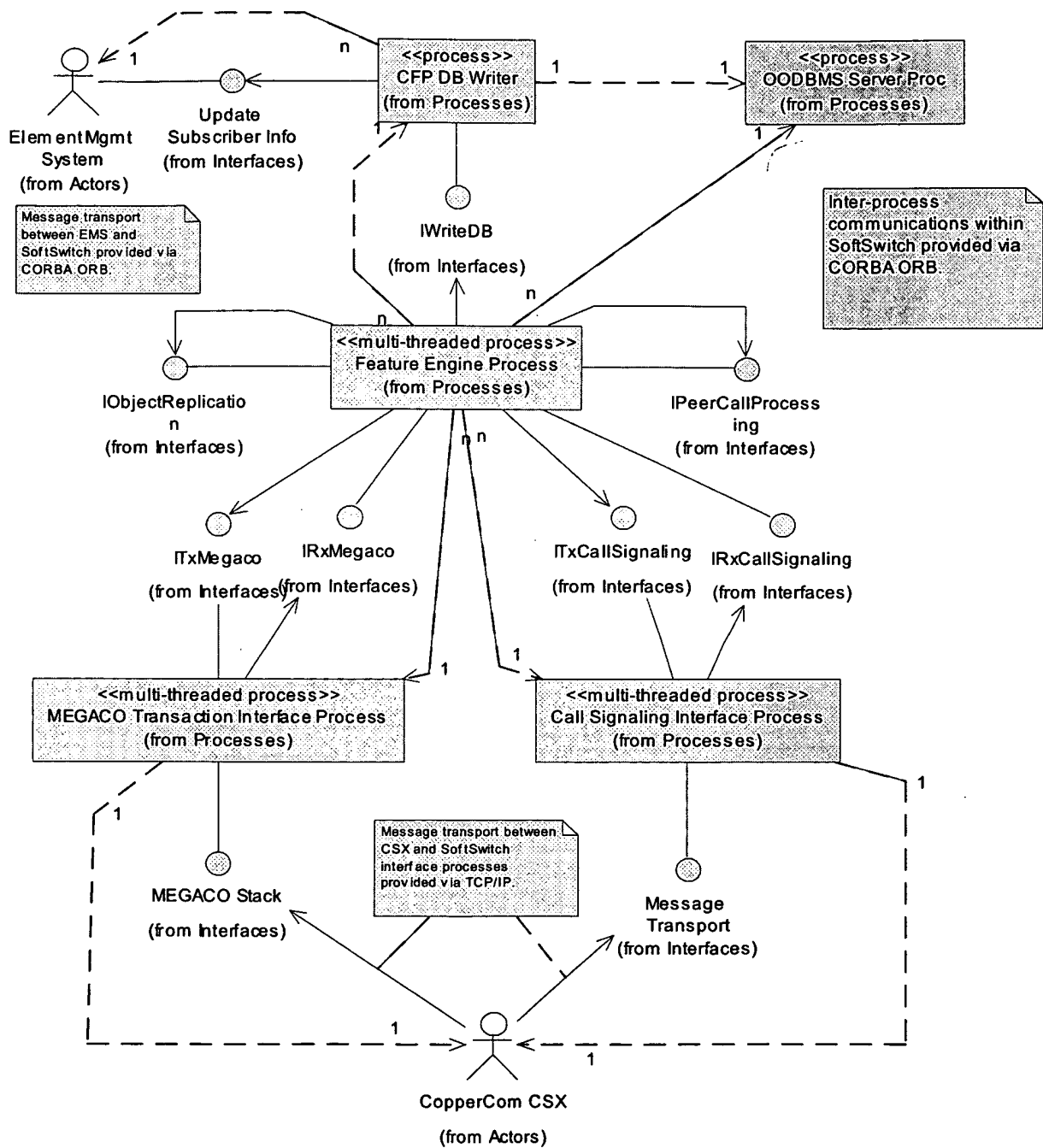


Figure 58